INVITATION TO BID #2019-000041

SPORTS PERFORMANCE CENTER WEIGHT ROOM REFRESH

ISSUE DATE: June 24, 2019

ITB DUE DATE/TIME: July 11, 2019, 2019 at 2:00 PM Pacific Time
***OFFICE IS CLOSED DAILY FROM NOON TO 1:00 PM**

MANDATORY PRE-BID CONFERENCE: July 3, 2019 at 1:00 PM Pacific Time in the Front Lobby area of the Sports Performance Center at 2737 SW Ralph Miller Lane, Corvallis, OR 97331.

QUESTION DEADLINE: July 5, 2019 at 5:00 PM Pacific Time

PROJECT NUMBER: 2147-18

CONTRACT ADMINISTRATOR:
Shoshana Shabazz, Purchasing Analyst
Construction Contract Administration
Oregon State University
644 SW 13th St.
Corvallis, OR 97333
Phone: (541) 737-0922
FAX: (541) 737-5546
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AWARD DECISION APPEALS:
Hanna Emerson, Construction Contracts Manager
Construction Contract Administration
Oregon State University
644 SW 13th St.
Corvallis, OR 97333
Phone: (541) 737-7342
FAX: (541) 737-5546
Email: hanna.emerson@oregonstate.edu

It is the Bidder's responsibility to continue to monitor the OSU Business and Bid Opportunities website for Addenda. Failure to acknowledge any Addenda in the Bid Form may cause your Bid to be considered non-responsive.

OSU standards and policies govern this solicitation (Procurement Thresholds and Methods, Procurement Solicitations and Contracts) unless otherwise referenced or stated.

P R O J E C T M A N U A L
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DRAWINGS

Prepared by Gensler dated June 12, 2019. Available for Download at the following link:
https://oregonstate.box.com/s/grtc8nvli4k1vjgrg79bi6058o5boej7

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OREGON STATE UNIVERSITY

NOTICE OF OPPORTUNITY

ADVERTISEMENT FOR BIDS

Oregon State University ("Owner") is accepting sealed bids from Contractors for a public improvement project at Construction Contracts Administration, Oregon State University, 644 SW 13th Street, Corvallis, Oregon, until 2:00 PM local time, July 11, 2019 for the Sports Performance Center Weight Room Refresh located on the campus of Oregon State University, Corvallis, Oregon.

A mandatory Pre-Bid Conference and examination of the site and conditions will take place on July 3, 2019 at 1:00 PM local time. Bidders shall meet with the Owner's Representatives in the Front Lobby area of the Sports Performance Center at 2737 SW Ralph Miller Lane, Corvallis, OR 97331. Attendance will be documented through a sign-in sheet prepared by the Owner's Representative. Prime bidders who arrive more than 5 minutes after start time of the meeting (as stated in the solicitation and by the Owner's Authorized Representative's watch) or after the discussion portion of the meeting (whichever comes first) shall not be permitted to sign in and will not be permitted to submit a bid on the project.

Bids will be due July 11, 2019 by 2:00 PM local time, at the Property Services Building, 644 SW 13th Street, Corvallis, Oregon.

Plans and specifications for this bid are available at the following website: https://bid.oregonstate.edu/

All bidders must comply with requirements of the prevailing wage law in ORS 279C.800 through ORS 279C.870. All bidders must be registered with the Construction Contractor's Board at the time of bid submission. No bid will be considered unless fully completed in the manner provided in the "Instructions to Bidders" upon the Bid Form provided. OSU encourages bids from Minority, Women, and Emerging Small Businesses.

OREGON STATE UNIVERSITY
CONSTRUCTION CONTRACTS ADMINISTRATION

DATE OF POSTING:
Monday, June 24, 2019

INSTRUCTIONS TO BIDDERS

OSU Policies and Standards (***Procurement Thresholds and Methods, Procurement Solicitations and Contracts)*** govern this OSU procurement process.

Article 1. Definitions

1.1. Capitalized words used herein but not defined shall have the meaning set forth in the OSU General Conditions and OSU Policies and Standards. The following terms used herein shall have the meaning set forth below:

"Bid Form"- refers to OSU form provided by Owner to be completed by Bidder.

"Project Manual"- The Project Manual includes, but is not necessarily limited to, the following: the Advertisement for Bids or Notice of Contracting Opportunity, these Instructions to Bidders, Supplemental Instructions to Bidders, Bid Form, Bid Bond, OSU General Conditions, Supplemental General Conditions (if any), Sample Supplement or Agreement, Performance Bond, Payment Bond, and the Plans and Specifications.

Article 2. Scope of Work

2.1 The Work contemplated in this document shall be for the Owner in connection with the Project described in the Project Manual.

Article 3. Examination of Site and Conditions

3.1 Before making a Bid, the Bidder shall examine the Work site to ascertain its physical condition. The Bidder shall be responsible for being fully informed as to the quality, quantity and sources of supply of the materials listed on the Project Manual. Failure to comply with this Section will not release Contractor from entering into the Contract nor excuse Contractor from performing the Work in strict accordance with the terms of the Contract Documents.

3.2 The Owner will not be responsible for any loss or unanticipated costs which may arise as a result of Contractor's failure to be fully informed in advance with regard to all conditions pertaining to the Work and the character of the Work required.

3.3. No statement made by any officer, agent, or employee of the Owner in relation to the physical conditions pertaining to the Work site or quality, quantity, and supply of materials will be binding on the Owner, unless included in writing in the Project Manual or an Addendum.

Article 4. Substitute Materials Approval Process

4.1 Prior to submitting a Bid including a Substitution, the Bidder must first seek approval of the Substitution from the Architect (or Engineer, as appropriate hereafter) by submitting a written request for approval at least 10 calendar days prior to the Closing Date and Time. The Bidder submitting the request shall be responsible for its timely delivery.

4.2 Substitution approval requests shall be accompanied by samples, records of performance, certified copies of tests by impartial and recognized laboratories, and such other information as the Architect may request.

4.3 Within a reasonable time after receiving such a request the Owner (or Architect if so designated) will consider whether the Substitution sought by Bidder is of equal value, utility, as the designated product in the Project Manual.

If the requested Substitution is approved an Addendum to the Project Manual shall be issued. A copy of each Addendum shall become a part of the Project Manual.

4.4 When the Architect approves a Substitution by Addendum, it is with the understanding that the Contractor guarantees the substituted article or material to be equal or better than the one specified.

Article 5. Interpretation of Project Manual

5.1 A Bidder in doubt as to the meaning of any part of the Project Manual may submit a written request for an interpretation to the Architect at any time prior to 10 calendar days prior to the Closing Date and Time.

5.2 Any interpretation of the Project Manual will be made only by a duly issued Addendum. The Owner will not be responsible for any other explanation or interpretation of the Project Manual nor for any other approval of a particular manufacturer's process or item.

5.3 To establish a basis of quality, certain processes, types of machinery and equipment or kinds of materials may be specified in the Project Manual either by description of process or by designating a manufacturer by name and referring to a brand or product designation or by specifying a kind of material. Whenever a process is designated or a manufacturer named, brand or item designation given, or whenever a process or material covered by patent is designated or described, it shall be understood that the words "or approved equal" follow such name, designation or description, whether they do so or not.

Article 6. Execution of the Bid Form

6.1 The Bid Form relates to Bids on a specific Project Manual. Only the amounts and information asked for on the Bid Form furnished by the Owner will be considered as the Bid. Each Bidder shall Bid upon the Work exactly as set forth in the Bid Form. The Bidder shall include in the Bid a sum to cover the cost of all items contemplated by the Project Manual. Bids that fail to address alternates set forth on the Bid Form may be considered non-responsive.

6.2 Each Bid Form must: 1) Be completed in accordance with these instructions; 2) Include the appropriate signatures as noted on the Bid Form; 3) Include numbers pertaining to base Bids stated both in writing and in figures; and 4) Include the Bidder's typed or clearly printed address.

6.3 When Bidding on an alternate for which there is no charge, the Bidder shall write the words "No Charge" in the space provided on the Bid Form. If one or more alternates is shown on the Bid Form, the Bidder shall indicate whether each is "add" or "deduct."

Article 7. Prohibition of Alterations to Bid

7.1 Bids which are incomplete, or contain ambiguities or conditions not provided for in the Bid Form, may be rejected.

Article 8. Submission of Bid

8.1 Each Bid shall be sealed in an envelope, properly addressed to the appropriate project representative of the Owner, showing on the outside of the envelope the name of the Bidder and the name of the project. Bids will be received at the time and place stated in the Advertisement for Bids.

Article 9. Bid Closing and Opening of Bids

9.1 All Bids must be received by the Owner before the Closing Date and Time. Any Bids received after the Closing

Date and Time will be rejected and returned to the Bidder unopened.

9.2 At the time of opening and reading of Bids, each Bid received, irrespective of any irregularities or informalities, will be publicly opened and read aloud.

Article 10. Acceptance or Rejection of Bids by Owner

10.1 Unless all Bids are rejected, the Owner will award the Contract based on the lowest responsive Bid from a responsible Bidder. If that Bidder does not execute the Contract, the Contract will be awarded to the next lowest responsible Bidder or Bidders in succession.

10.2 The procedures for Contract awards shall be in compliance with the provisions of OSU Standards adopted by the Owner.

10.3 The Owner reserves the right to reject all Bids and to waive minor informalities.

10.4 The Owner reserves the right to hold the Bid and any required Bid security, of the three lowest Bidders for a period of 30 calendar days from the time of Bid opening pending award of the Contract. Following award of the Contract, any Bid security furnished by the three lowest Bidders may be held 20 calendar days pending execution of the Contract. All other Bids will be rejected and Bid security returned.

10.5 In determining the lowest Bidder, the Owner reserves the right to take into consideration any or all authorized base Bids as well as alternates or combinations indicated in the Bid Form.

10.6 If Owner has not accepted a Bid within 30 calendar days after the opening of the Bids, each of the three lowest Bidders may withdraw the Bid submitted and request the return of any Bid security then held.

Article 11. Withdrawal of Bid

11.1 At any time prior to the Closing Date and Time a Bidder may withdraw its Bid. This will not preclude the submission of another Bid by such Bidder prior to the Closing Date and Time.

11.2 After the Closing Date and Time, no Bidder will be permitted to withdraw its Bid within the time period specified in Article 10 for award and execution, except as provided for in that Article.

Article 12. Execution of Contract, Agreement, Performance Bond and Payment Bond

12.1 The Owner will provide the successful Bidder with Contract Documents within 10 calendar days after the award of the Contract. The Bidder shall be required to execute the Contract as provided, including a Performance Bond and a Payment Bond from a surety company licensed to do surety business in the State of Oregon, within 20 calendar days after the award of the Contract. The Contract Documents shall be delivered to the Owner in the manner stated in the Notice of Award.

Article 13. Recyclable Products

13.1 Contractors must use recyclable products to the maximum extent economically feasible in the performance of the Contract.

OREGON STATE UNIVERSITY

BID FORM

PROJECT: SPORTS PERFORMANCE CENTER WEIGHT ROOM REFRESH

BID DUE DATE/TIME: JULY 11, 2019 AT 2:00 PM PACIFIC TIME

FROM: _____
Name of Contractor

TO: Oregon State University ("Owner")
Construction Contract Administration
3015 SW Western Blvd.
Corvallis, Oregon 97333

1. The Undersigned (*check one of the following and insert information requested*):

____a. An individual doing business under an assumed name registered under the laws of the State of _____; or

____b. A partnership registered under the laws of the State of _____; or

____c. A corporation organized under the laws of the State of _____; or

____d. A limited liability corporation/company organized under the laws of the State of _____;

hereby proposes to furnish all material and labor and perform all work hereinafter indicated for the above project in strict accordance with the Contract Documents for the Base Bid as follows:

_____Dollars ($_____)

and the Undersigned agrees to be bound by the following documents:

- Notice of Opportunity
- Instructions to Bidders
- Supplemental Instructions to Bidders
- Sample Contract
- Performance Bond and Payment Bond
- OSU General Conditions
- Supplemental OSU General Conditions
- Prevailing Wage Rates
- Payroll and Certified Statement Form
- Plans and Specifications
- Drawings and Details

- ADDENDA numbered ____ through____, inclusive *(fill in blanks)*

2. The Undersigned proposes to add to or deduct from the Base Bid indicated above the items of work relating to the following Alternate(s) as designated in the Specifications:

ALTERNATE 1: Provide a price to furnish and install 1 card reader at existing Vestibule Door #V104D and 4 interior security cameras.

ADD/DEDUCT: $_____

3. The work shall be completed within the time stipulated and specified in Division 1 of the Specifications.

4. The Undersigned certifies that: (1) This Bid has been arrived at independently and is being submitted without collusion with and without any agreement, understanding, or planned common course of action with any other vendor of materials, supplies, equipment or services described in the invitation to bid designed to limit independent bidding or competition; and (2) The contents of the Bid have not been communicated by the Undersigned or its employees or agents to any person not an employee or agent of the Undersigned or its surety on any Bond furnished with the Bid and will not be communicated to such person prior to the official opening of the Bid.

5. The undersigned **HAS, HAS NOT** (*circle applicable status*) paid unemployment or income taxes in Oregon within the past 12 months and **HAS, HAS NOT** (*circle applicable status*) a business address in Oregon.

6. The Undersigned agrees, if awarded a contract, to comply with the provisions of ORS 279C.800 through 279C.870 pertaining to the payment of the prevailing rates of wage.

7. Contractor's CCB registration number is _____. As a condition to submitting a bid, a Contractor must be registered with the Oregon Construction Contractors Board in accordance with ORS 701.035 to 701.055, and disclose the registration number. Failure to register and disclose the number will render the bid unresponsive and it will be rejected, unless contrary to federal law.

8. The successful Bidder hereby certifies that all subcontractors who will perform construction work as described in ORS 701.005(2) were registered with the Construction Contractors Board in accordance with ORS 701.035 to 701.055 at the time the subcontractor(s) made a bid to work under the Contract.

9. The successful Bidder hereby certifies that, in compliance with the Worker's Compensation Law of the State of Oregon, its Worker's Compensation Insurance provider is _____, Policy No. _____, and that Contractor shall submit Certificates of Insurance as required.

10. Contractor's Project Manager for this project is: _____,
Office Phone: _____ Cell Phone: _____.

11. The Undersigned certifies that it has not discriminated against minority, women, or emerging small businesses in obtaining any subcontracts for this project.

12. The Undersigned agrees, if awarded the Contract, to execute and deliver to Owner, within twenty (20) calendar days after receiving the Contract Documents, an Agreement Form and a satisfactory Performance Bond and Payment Bond, each in an amount equal to one hundred (100) percent of the Contract sum, using forms provided by the Owner. The surety requested to issue the Performance Bond and Payment Bond will be: _____.

(name of surety company - not insurance agency) The Undersigned hereby authorizes said surety company to disclose any information to the Owner concerning the Undersigned's ability to supply a Performance Bond and Payment Bond each in the amount of the Contract.

By signature below, Contractor agrees to be bound by this Bid.

NAME OF FIRM _____

ADDRESS _____

_____

FEDERAL TAX ID _____

TELEPHONE NO _____

FAX NO _____

SIGNATURE 1) _____
Sole Individual - Signature

_____
Sole Individual - Printed Name

or 2) _____
Partner

or 3) _____
Authorized Officer of Corporation - Signature

_____
Authorized Officer of Corporation Printed Name

(SEAL)

_____
Attested: Secretary of Corporation

Payment information will be reported to the IRS under the name and taxpayer ID # provided above. Information not matching IRS records could subject Contractor to 31 percent backup withholding.

***** ***END OF BID*** *****

OREGON STATE UNIVERSITY
PUBLIC IMPROVEMENT CONTRACT

This Public Improvement Contract for the **(Insert Project Name)** (the "Contract"), made by and between Oregon State University, hereinafter called OWNER, and **(Insert Contractor's Name)** hereinafter called the CONTRACTOR (collectively the "Parties"), shall become effective on **(Insert contract award date)**, or the date this Contract has been signed by all the Parties, whichever is later.

1. Contract Price, Contract Documents and Work.

The CONTRACTOR, in consideration of the sum of _____ (the "Contract Price"), to be paid to the CONTRACTOR by OWNER in the manner and at the time hereinafter provided, and subject to the terms and conditions provided for in the Instructions to Bidders and other Contract Documents (as defined in the Oregon State University General Conditions referenced within the Instructions to Bidders), all of which are incorporated herein by reference, hereby agrees to perform all Work described and reasonably inferred from the Contract Documents. The Contract Price is the amount contemplated by the Base Bid adjusted for Alternates____, as indicated in the accepted Bid.

Also, the following documents are incorporated by reference in this Contract and made a part hereof if checked for inclusion [X]:

[ ] (RESERVED)

2. Representatives.

CONTRACTOR has named **(Insert Name)** its' Authorized Representative to act on its behalf. OWNER designates, or shall designate, its Authorized Representative as indicted below (check one):

A. [ ] Unless otherwise specified in the Contract Documents, the OWNER designates **(Insert Name)** as its Authorized Representative in the administration of this Contract. The above-named individual shall be the initial point of contact for matters related to Contract performance, payment authorization, and to carry out the responsibilities of the OWNER.

B. [X] Name of OWNER'S Authorized Representative shall be submitted by OWNER in a separate writing.

3. Contract Dates.

COMMENCEMENT DATE: Within **(Insert # of Days)** days of the execution of the Contract ("Execution").

SUBSTANTIAL COMPLETION DATE: **(Insert # of Days)** from Contract Execution **(or a date certain)**.

FINAL COMPLETION DATE: **(Insert # of Days)** from Contract Execution **(or a date certain)**.

4. Integration

The Contract documents constitute the entire agreement between the parties. There are no other understandings, agreements or representations, oral or written, not specified herein regarding this Contract.

CONTRACTOR, by the signature below of its authorized representative, hereby acknowledges that it has read this Contract, understands it, and agrees to be bound by its terms and conditions.

In witness whereof, Oregon State University executes this Contract and the CONTRACTOR does execute the same as of the day and year indicated below.

CONTRACTOR DATA:
(Insert Contractor Name & Address)

CONTRACTOR NAME:

CONTRACTOR FEDERAL ID #

CONTRACTOR CCB #

[Payment information will be reported to the IRS under the name and taxpayer ID # provided above. Information must be provided prior to contract approval. Information not matching IRS records could subject Contractor to 31 percent backup withholding.]

CONTRACTOR SIGNATURE

By_____
Name/Title Date

Oregon State University

By_____

Michael J. Green Date
Vice President for Finance and Administration

OREGON STATE UNIVERSITY

PERFORMANCE BOND

Bond No._____
Solicitation _____
Project Name _____

_____(Surety #1)	Bond Amount No. 1:	$_____
_____(Surety #2)*	Bond Amount No. 2:*	$_____
* *If using multiple sureties*	Total Penal Sum of Bond:	$_____

We, _____as Principal, and the above identified Surety(ies), authorized to transact surety business in Oregon, as Surety, hereby jointly and severally bind ourselves, our respective heirs, executors, administrators, successors and assigns firmly by these presents to pay unto Oregon State University (OSU), the sum of (Total Penal Sum of Bond)

_____

(Provided, that we the Sureties bind ourselves in such sum "jointly and severally" as well as "severally" only for the purpose of allowing a joint action or actions against any or all of us, and for all other purposes each Surety binds itself, jointly and severally with the Principal, for the payment of such sum only as is set forth opposite the name of such Surety), and

WHEREAS, the Principal has entered into contract No. _____with the OSU, the plans, specifications, terms and conditions of which are contained within the Contract resulting from the above-referenced Solicitation;

WHEREAS, the terms and conditions of the Contract, together with applicable plans, standard specifications, special provisions, schedule of performance, and schedule of Contract prices, are made a part of this Performance Bond by reference, whether or not attached to the contract (all hereafter called "Contract"); and

WHEREAS, the Principal has agreed to perform the Contract in accordance with the terms, conditions, requirements, plans and specifications, and all authorized modifications of the Contract which increase the amount of the work, the amount of the Contract, or constitute an authorized extension of the time for performance, notice of any such modifications hereby being waived by the Surety:

NOW, THEREFORE, THE CONDITION OF THIS BOND IS SUCH that if the Principal herein shall (1) faithfully and truly observe and comply with the terms, conditions and provisions of the Contract, in all respects, (2) shall well and truly and fully do and perform all matters and things undertaken by Contractor to be performed under the Contract, upon the terms set forth therein, and within the time prescribed therein, or as extended as provided in the Contract, with or without notice to the Sureties, (3) shall save, defend, indemnify and hold harmless OSU and its officers, board members, employees, agents and other representatives, against any direct or indirect damages or claim of every kind and description that shall be suffered or claimed to be suffered in connection with or arising out of the performance of the Contract by

the Principal or its subcontractors, and (4) shall in all respects perform said contract according to law, then this obligation is to be void; otherwise, it shall remain in full force and effect.

Nonpayment of the bond premium will not invalidate this bond, nor shall OSU be obligated for the payment of any premiums.

This bond is given and received under authority of ORS Chapters 279C and 352, the provisions of which hereby are incorporated into this bond and made a part hereof.

IN WITNESS WHEREOF, WE HAVE CAUSED THIS INSTRUMENT TO BE EXECUTED AND SEALED BY OUR DULY AUTHORIZED LEGAL REPRESENTATIVES.

Dated this _____ day of _____, 20__.

PRINCIPAL: _____

By_____
Signature

_____
Official Capacity

Attest: _____
Corporation Secretary

SURETY: __ _____
[Add signatures for each surety if using multiple bonds]

BY ATTORNEY-IN-FACT:
[Power-of-Attorney must accompany each surety bond]

_____
Name

_____
Signature

_____
Address

_____
City State Zip

_____ _____
Phone Fax

OREGON STATE UNIVERSITY

PAYMENT BOND

Bond No. _____
Solicitation _____
Project Name _____

_____(Surety #1)	Bond Amount No. 1:	$ _____
_____(Surety #2)*	Bond Amount No. 2:*	$ _____
* *If using multiple sureties*	Total Penal Sum of Bond:	$ _____

We, _____, as Principal, and the above identified Surety(ies), authorized to transact surety business in Oregon, as Surety, hereby jointly and severally bind ourselves, our respective heirs, executors, administrators, successors and assigns firmly by these presents to pay unto Oregon State University (OSU) the sum of (Total Penal Sum of Bond) _____ _____ (Provided, that we the Sureties bind ourselves in such sum "jointly and severally" as well as "severally" only for the purpose of allowing a joint action or actions against any or all of us, and for all other purposes each Surety binds itself, jointly and severally with the Principal, for the payment of such sum only as is set forth opposite the name of such Surety), and

WHEREAS, the Principal has entered into contract No. _____ with OSU, the plans, specifications, terms and conditions of which are contained within the Contract resulting from the above-referenced Solicitation;

WHEREAS, the terms and conditions of the contract, together with applicable plans, standard specifications, special provisions, schedule of performance, and schedule of contract prices, are made a part of this Payment Bond by reference, whether or not attached to the contract (all hereafter called "Contract"); and

WHEREAS, the Principal has agreed to perform the Contract in accordance with the terms, conditions, requirements, plans and specifications, and schedule of contract prices which are set forth in the Contract and any attachments, and all authorized modifications of the Contract which increase the amount of the work, or the cost of the Contract, or constitute authorized extensions of time for performance of the Contract, notice of any such modifications hereby being waived by the Surety:

NOW, THEREFORE, THE CONDITION OF THIS BOND IS SUCH that if the Principal shall (1) faithfully and truly observe and comply with the terms, conditions and provisions of the Contract, in all respects, (2) shall well and truly and fully do and perform all matters and things by it undertaken to be performed under said Contract and any duly authorized modifications that are made, upon the terms set forth therein, and within the time prescribed therein, or as extended therein as provided in the Contract, with or without notice to the Sureties, (3) shall save, defend, indemnify and hold harmless OSU, and its officers, board members, employees, agents and other representatives, against any claim for direct or indirect damages of every kind and description that shall be suffered or claimed to be suffered in connection with or arising out of the performance of the Contract by the Contractor or its subcontractors, (4) shall promptly pay all persons supplying labor, materials or both to the Principal or its subcontractors for prosecution of the work provided in the Contract; (5) shall promptly pay all contributions due the State Industrial Accident Fund and the State Unemployment Compensation Fund from the Principal or its

subcontractors in connection with the performance of the Contract; (6) shall pay over to the Oregon Department of Revenue all sums required to be deducted and retained from the wages of employees of the Principal and its subcontractors pursuant to ORS 316.167;(7) shall permit no lien nor claim to be filed or prosecuted against the State or OSU on account of any labor or materials furnished; and (8) shall do all things required of the Principal by the laws of this State, then this obligation shall be void; otherwise, it shall remain in full force and effect.

Nonpayment of the bond premium will not invalidate this bond, nor shall OSU be obligated for the payment of any premiums.

This bond is given and received under authority of ORS Chapters 279C and 352, the provisions of which hereby are incorporated into this bond and made a part hereof.

IN WITNESS WHEREOF, WE HAVE CAUSED THIS INSTRUMENT TO BE EXECUTED AND SEALED BY OUR DULY AUTHORIZED LEGAL REPRESENTATIVES:

Dated this _____day of _____, 20__.

PRINCIPAL: _____

By _____
Signature

_____
Official Capacity

Attest: _____
Corporation Secretary

SURETY: _____
[Add signatures for each if using multiple bonds]

BY ATTORNEY-IN-FACT:
[Power-of-Attorney must accompany each bond]

_____
Name

_____
Signature

_____
Address

_____
City State Zip

_____
Phone Fax

OREGON STATE UNIVERSITY
GENERAL CONDITIONS
FOR PUBLIC IMPROVEMENT CONTRACTS

June 30, 2017

INSTRUCTIONS: The attached **Oregon State University General Conditions for Public Improvement Contracts ("Public Improvement General Conditions")** apply to all designated Public Improvement contracts. Changes to the Public Improvement General Conditions (including any additions, deletions or substitutions) should only be made by attaching Public Improvement Supplemental General Conditions. The text of these Public Improvement General Conditions should not otherwise be altered.

TABLE OF SECTIONS

SECTION A
GENERAL PROVISIONS

A.1 DEFINITION OF TERMS

In the Contract Documents the following terms shall be as defined below:

AMENDMENT, means a writing which, when fully executed by the Parties to this Contract, constitutes a change to a Contract Document. Amendments shall be issued in accordance with the changes provisions of Section D and, if applicable, establish a Contract Price or Contract Time adjustment.

APPLICABLE LAWS, means federal, state and local laws, codes, rules, regulations and ordinances applicable to the Work and to the Contract.

ARCHITECT/ENGINEER, means the Person appointed by the Owner to make drawings and specifications and, to provide contract administration of the Work contemplated by the Contract to the extent provided herein or by supplemental instruction of Owner (under which Owner may delegate responsibilities to the Architect/Engineer), in accordance with ORS Chapter 671 (Architects) or ORS Chapter 672 (Engineers) and administrative rules adopted thereunder.

CHANGE ORDER, means a written order issued by the Owner to be later included as an Amendment. A Change Order shall not be effective until codified as an Amendment.

CLAIM, means a demand by Contractor pursuant to Section D.3 for review of the denial of Contractor's initial request for an adjustment of Contract terms, payment of money, extension of Contract Time or other relief, submitted in accordance with the requirements and within the time limits established for review of Claims in these Public Improvement General Conditions.

CONSTRUCTION CHANGE DIRECTIVE, means a written order by the Owner to the Contractor requiring a change in the Work within the general scope of the Contract Documents, issued under the changes provisions of Section D.

CONSTRUCTION SCHEDULE, means the schedule prepared by the Contractor in CPM format and approved by the Owner, and all adjustments thereto approved by the Owner, that describes sequence and timing of the Work.

CONTRACT, means the written agreement between the Owner and the Contractor comprised of the Contract Documents which describe the Work to be done and the obligations between the parties.

CONTRACT DOCUMENTS, means the Public Improvement Contract, Public Improvement General Conditions, Supplemental General Conditions if any, the accepted Offer, Plans, Specifications, Construction Change Directives, Solicitation Document and addenda thereto, Instructions to Offerors, and Supplemental Instructions to Offerors, the CM/GC's RFQ proposal, the GMP Amendment, and any other Amendment, the Construction Schedule prepared and approved in accordance with the Construction Documents, and all other required Submittals.

CONTRACT PERIOD, as set forth in the Contract Documents, means the total period of time beginning with the full execution of a Contract and, if applicable, the issuance of a Notice to Proceed and concluding upon Final Completion.

CONTRACT PRICE, means the total of the awarded Offer amount, as increased or decreased by the price of approved alternates, as indicated in the Contract Documents.

CONTRACT TIME, means any incremental period of time allowed under the Contract to complete any portion of the Work as reflected in the project schedule.

CONTRACTOR, means the Person awarded the Contract for the Work contemplated.

CPM, means a critical path method format to be used for the Construction Schedule.

DAYS, are calendar days, including weekdays, weekends and holidays, unless otherwise specified.

DIRECT COSTS, means, unless otherwise provided in the Contract Documents, the cost of materials, including sales tax, cost of delivery; cost of labor, including social security, Medicare and unemployment insurance, and fringe benefits required by agreement or custom; worker's compensation insurance; project specific insurance (including, without limitation, Builder's Risk Insurance and Builder's Risk Installation Floater); bond premiums, rental cost of equipment, and machinery required for execution of the Work; and the additional costs of field personnel directly attributable to the Work.

FINAL COMPLETION, means the final completion of all requirements under the Contract, including Contract Closeout as described in Section K but excluding Warranty Work as described
in Section I.2, and the final payment and release of all retainage, if any, released.

FINAL PAYMENT, means the last payment to the Contractor, including retainage, in connection with the Work.

FORCE MAJEURE, means an act, event or occurrence caused by f i r e , riot, war, acts of God, nature, sovereign, or public enemy, strikes, freight embargoes or any other act, event or occurrence that is beyond the control of the party to this Contract who is asserting Force Majeure.

MWESB REPORT, means an accurate report by the Contractor to the Owner identifying all Minority, Women and Emerging Small Business (MWESB) enterprises, as those terms are defined in ORS 200.005, receiving contracts throughout the course of the Work. An initial MWESB report is required (see Section E.2.9) and MWESB Reports are required annually (see Section E.2.9) and as a condition of final payment (see Section K.1). The initial report shall include the total number of contracts and subcontracts awarded to MWESB enterprises and the dollar value of their respective contracts and subcontracts. The annual reports shall include the total number of contracts and subcontracts awarded to MWESB enterprises, the dollar value of each, and the expenditure toward each contract and subcontract during the previous twelve (12) months. The final report shall include the total number of contracts and subcontracts awarded to MWESB enterprises and the dollar value of their respective contracts and subcontracts including all Contracts and Amendments incorporated during the course of the project. The reports shall only include enterprises certified with the State of Oregon as MWESB enterprises and shall include individual identification of each enterprise as a Minority business enterprise, a Women business enterprise, and/or an Emerging Small Business Enterprise, as applicable.

NOTICE TO PROCEED, means the official written notice from the Owner stating that the Contractor is to proceed with the Work defined in the Contract Documents. Notwithstanding the Notice to Proceed, Contractor shall not be authorized to proceed with the Work until all initial Contract requirements, including the Contract, performance bond and payment bond, and certificates of insurance, have been fully executed and submitted to Owner in a suitable form.

OFFER, means a bid in connection with Instructions to Bidders or a proposal in connection with a Request for Proposals.

OFFEROR, means a bidder in connection with Instructions to Bidders or a proposer in connection with a Request for Proposals.

OVERHEAD, means those items which may be included in the Contractor's markup (general and administrative expense and profit) and that shall not be charged as Direct Cost of the Work,
including without limitation such Overhead expenses as wages or salary of personnel above the level of foreman (i.e., superintendents and project managers), expenses of Contractor's offices and supplies at the job site (e.g. job trailer) and at Contractor's principal place of business and including expenses of personnel staffing the job site office and Contractor's principal place of business, and Commercial General Liability Insurance and Automobile Liability Insurance.

OWNER, means Oregon State University(OSU). Owner may elect, by written notice to Contractor, to delegate certain duties to more than one party, including without limitation, to an Architect/Engineer. However, nothing in these Public Improvement General Conditions is intended to abrogate the separate design professional responsibilities of Architects under ORS Chapter 671 or of Engineers under ORS Chapter 672.

PERSON, means a natural person or entity doing business as a sole proprietorship, a partnership, a joint venture, a corporation, a limited liability company or partnership, or any other entity possessing the legal capacity to contract.

PLANS, means the drawings which show the location, type, dimensions, and details of the Work to be done under the Contract.

PROJECT, means the development, design, construction

PUNCH LIST, means the list of Work yet to be completed or deficiencies which need to be corrected in order to achieve Final Completion of the Contract.

RECORD DOCUMENT, means the as-built Plans, Specifications, testing and inspection records, product data, samples, manufacturer and distributor/supplier warranties evidencing transfer of ownership to Owner, operational and maintenance manuals, shop drawings, Construction Change Directives, MWESB Reports, correspondence, certificate(s) of occupancy, and other documents listed in Subsection B.9.1 of these Public Improvement General Conditions, recording all Services performed.

SOLICITATION DOCUMENT, means Instructions to Bidders or Offerors or a Request for Proposal or a Request for Quotes.

SPECIFICATION, means any description of the physical or functional characteristics of the Work, or of the nature of a supply, service or construction item. Specifications may include a description of any requirement for inspecting, testing or preparing a supply, service or construction item for delivery and the quantities or qualities of materials to be furnished under the Contract. Specifications generally will state the results or products to be obtained and may, on occasion, describe the method and manner of doing the Work to be performed. Specifications may be incorporated by reference and/or may be attached to the Contract.

SUBCONTRACT, means a contract between the Contractor and a subcontractor for the performance of a portion of the Work.

SUBCONTRACTOR, means a Person having a direct contract with the Contractor, or another Subcontractor, to perform one or more items of the Work.

SUBMITTAL, means a shop drawing, product data, sample, catalog cut, or similar item for specific portions of the Work as required by the Construction Documents.

SUBSTANTIAL COMPLETION, means the date when the Owner accepts in writing the construction, alteration or repair of the improvement to real property constituting the Work or any designated portion thereof as having reached that state of completion when it may be used or occupied for its intended purpose. Substantial Completion of facilities with operating systems occurs only after thirty (30) continuous Days of successful, trouble-free operation of the operating systems as provided in Section K.3.2.

SUBSTITUTIONS, means items that in function, performance, reliability, quality, and general configuration are the same or better than the product(s) specified. Approval of any substitute item shall be solely determined by the Owner. The decision of the Owner is final.

PUBLIC IMPROVEMENT SUPPLEMENTAL GENERAL CONDITIONS, means those conditions that remove from, add to, or modify these Public Improvement General Conditions. Public Improvement Supplemental General Conditions may be included in the Solicitation Document or may be a separate attachment to the Contract.

WORK, means the furnishing of all materials, equipment, labor, transportation, services and incidentals necessary to successfully complete any individual item or the entire Contract and the carrying out of duties and obligations imposed by the Contract Documents.

A.2 SCOPE OF WORK

The Work contemplated under this Contract includes all labor, materials, transportation, equipment and services for, and incidental to, the completion of all construction work in connection with the project described in the Contract Documents. The Contractor shall perform all Work necessary so that the project can be legally occupied and fully used for the intended use as set forth in the Contract Documents. Execution of the Contract by the Contractor is an express representation (1) that the Contractor understands the intent stated herein with respect to the Preconstruction Phase Services, and (2) the Contractor's execution of an Amendment, including the GMP Amendment, shall be an express and unqualified representation that the Contractor understands the intent stated herein and therein.

A.3 INTERPRETATION OF CONTRACT DOCUMENTS

A.3.1 Unless otherwise specifically defined in the Contract

Documents, words which have well-known technical meanings or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings. Contract Documents are intended to be complementary. Whatever is called for in one, is interpreted to be called for in all. However, in the event of conflicts or discrepancies among the Contract Documents, interpretations will be based on the following descending order of precedence:

(a) Amendments and Construction Change Directives, with those of later date having precedence over those of an earlier date;

(b) The Supplemental General Conditions;

(c) Public Improvement General Conditions;

(d) The Public Improvement Contract;

(e)) Construction Change Directive;

(f) Division One (General Requirements) of the Specifications;

(g) Detailed Schedules of finishes, equipment and other items included in the Specifications;

(h) Plans and Specifications (other than Division One and the Detailed Schedules to the Specifications);

(i) Large-scale drawings on Plans;

(j) Small-scale drawings on Plans;

(k) Dimension numbers written on Plans which shall prevail and take precedence over dimensions scaled from Plans;

(l) The Solicitation Document, and any addenda thereto.

(m) The Contractor's RFQ proposal.

A.3.2 In the case of an inconsistency between Plans and Specifications or within either document not clarified by addendum, the better quality or greater quantity of Work shall be provided in accordance with the Owner's interpretation in writing.

A.3.3 If the Contractor finds discrepancies in, or omissions from the Contract Documents, or if the Contractor is in doubt as to their meaning, the Contractor shall at once notify the Owner in writing. Matters concerning and interpretation of requirements of the Contract Documents will be decided by the Owner, who may delegate that duty in some instances to the Architect/Engineer. Responses to Contractor's requests for interpretation of Contract Documents will be made in writing by Owner (or the Architect/Engineer) within any time limits agreed upon or otherwise with reasonable promptness. Interpretations and decisions of the Owner (or Architect/Engineer) will be consistent with the intent of and reasonably inferable from the Contract Documents. Contractor shall not proceed without direction in writing from the Owner (or Architect/Engineer).

A.3.4 References to standard specifications, manuals, codes of any technical society, organization or association, to the laws or regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code, laws or regulations in effect in the jurisdiction where the project is occurring on the first published date of the Solicitation Document, except as may be otherwise specifically stated.

A.4 EXAMINATION OF PLANS, SPECIFICATIONS, AND SITE

A.4.1 It is understood that the Contractor, before submitting an Offer, has made a careful examination of the Contract Documents; has become fully informed as to the quality and quantity of materials and the character of the Work required; and has made a careful examination of the location and conditions of the Work and the sources of supply for materials. The Owner will in no case be responsible for any loss or for any unanticipated costs that may be suffered by the Contractor as a result of the Contractor's failure to acquire full information in advance in regard to all conditions pertaining to the Work. No oral agreement or conversation with any officer, agent, or personnel of the Owner, or with the Architect/Engineer either before or after the e x e c u t i o n of this Contract, shall affect or modify any of the terms or obligations herein contained.

A.4.2 Should the Plans or Specifications fail to particularly describe the materials, kind of goods, or details of construction of any aspect of the Work, Contractor shall have the duty to make inquiry of the Owner and Architect/Engineer as to what is required prior to performance of the Work. Absent Specifications to the contrary, the materials or processes that would normally be used to produce first quality finished Work shall be considered a part of the Contract requirements.

A.4.3 Any design errors or omissions noted by the Contractor shall be reported promptly to the Owner and confirmed in writing, including without limitation, any nonconformity with Applicable Laws.

A.4.4 If the Contractor believes that adjustments to cost or Contract Time is involved because of clarifications or instructions issued by the Owner (or Architect/Engineer) in response to the Contractor's notices or requests for information, the Contractor must submit a written request to the Owner, setting forth the nature and specific extent of the request, including all time and cost impacts against the Contract as soon as possible, but no later than thirty (30) Days after receipt by Contractor of the clarifications or instructions issued. If the Owner denies Contractor's request for additional compensation, additional Contract Time, or other relief that Contractor believes results from the clarifications or instructions, the Contractor may proceed to file a Claim under Section D.3, Claims Review Process. If the Contractor fails to perform the obligations of Sections A.4.1 to A.4.3, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations.

A.5 INDEPENDENT CONTRACTOR STATUS

The service or services to be performed under this Contract are those of an independent contractor as defined in ORS 670.600.

Contractor represents and warrants that it is not an officer, employee or agent of the Owner as those terms are used in ORS 30.265.

A.6 RETIREMENT SYSTEM STATUS AND TAXES

Contractor represents and warrants that it is not a contributing member of the Public Employees' Retirement System and will be responsible for any federal or state taxes applicable to payment r e c e i v e d under this Contract. Contractor will not be eligible for any benefits from these Contract payments of federal Social Security, employment insurance, workers' compensation or the Public Employees' Retirement System, except as a self-employed individual. Unless the Contractor is subject to backup withholding, Owner will not withhold from such payments any amount(s) to cover Contractor's federal or state tax obligations.

A.7 GOVERNMENT EMPLOYMENT STATUS

A.7.1 If this payment is to be charged against federal funds, Contractor represents and warrants that it is not currently employed by the Federal Government. This does not preclude the Contractor f r o m holding another contract with the Federal Government.

A.7.2 Contractor represents and warrants that Contractor is not an employee of the State of Oregon for purposes of performing Work under this Contract

SECTION B
ADMINISTRATION OF THE CONTRACT

B.1 OWNER'S ADMINISTRATION OF THE CONTRACT

B.1.1 The Owner shall administer the Contract as described in the Contract Documents (1) during construction (2) until Final Payment is due and (3) during the one-year period for correction of Work. The Owner will act as provided in the Contract Documents, unless modified in writing in accordance with other provisions of the Contract. In performing these tasks, the Owner may rely on the Architect/Engineer or other consultants to perform some or all of these tasks.

B.1.2 The Owner will visit the site at intervals appropriate to the stage of the Contractor's operations (1) to become generally familiar with and to keep the Owner informed about the progress and quality of the portion of the Work completed, (2) to endeavor to guard the Owner against defects and deficiencies in the Work, and (3) to determine in general if Work is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. The Owner will not make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Owner will neither have control over or charge of, nor be responsible for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work. Inspection of the progress, quantity, or quality of the Work done by the Owner, any Owner representative, and public agency, the Architect/Engineer, or any inspector, shall not relieve the Contractor of any responsibility for the compliance of all Work with the Contract Documents.

B.1.3 Except as otherwise provided in the Contract Documents or when direct communications have been specifically authorized, the Owner and Contractor shall communicate with each other about matters arising out of or relating to the Contract. Communications by and with the Architect/Engineer's consultants shall be through the Architect/Engineer. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the Owner.

B.2 Based upon the Architect/Engineer's evaluations of the Contractor's Application for Payment, or unless otherwise stipulated by the Owner, the Architect/Engineer will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts. CONTRACTOR'S MEANS AND METHODS; MITIGATION OF IMPACTS

B.2.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions concerning these matters. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences or procedures.

B.2.2 The Contractor is responsible to protect and maintain the Work during the course of construction and to mitigate any adverse impacts to the project, including those caused by authorized changes, which may affect cost, schedule, or quality.

B.2.3 The Contractor is responsible for the actions of all its personnel, laborers, suppliers, and Subcontractors on the project. The Contractor shall enforce strict discipline and good order among Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of persons who are unfit or unskilled for the tasks assigned to them.

B.3 MATERIALS AND WORKMANSHIP

B.3.1 The intent of the Contract Documents is to provide for the construction and completion in every detail of the Work described. All Work shall be performed in a professional manner and unless the means or methods of performing a task are specified elsewhere in the Contract Documents, Contractor shall employ methods that are generally accepted and used by the industry, in accordance with industry standards.

B.3.2 The Contractor is responsible to perform the Work as required by the Contract Documents. Defective Work shall be corrected at the Contractor's expense.

B.3.3 Work done and materials furnished shall be subject to inspection and/or observation and testing by the Owner to determine if they conform to the Contract Documents. Inspection of the Work by the Owner does not relieve the Contractor of responsibility for the Work in accordance with the Contract Documents.

B.3.4 Contractor shall furnish adequate facilities, as required, for the Owner to have safe access to the Work including without limitation walkways, railings, ladders, tunnels, and platforms. Producers, suppliers, and fabricators shall also provide proper facilities and access to their

facilities.

B.3.5 The Contractor shall furnish Samples of materials for testing by the Owner and include the cost of the Samples in the Contract Price.

B.4 PERMITS

Contractor shall obtain and pay for all necessary permits, licenses and fees, except for those specifically excluded in the Supplemental General Conditions, for the construction of the Work, for temporary obstructions, enclosures, opening of streets for pipes, walls, utilities, environmental Work, etc., as required for the project.
Contractor shall be responsible for all violations of the law, in connection with the construction or caused by obstructing streets, sidewalks or otherwise. Contractor shall give all requisite notices to public authorities.

B.5 COMPLIANCE WITH GOVERNMENT REGULATIONS

B.5.1 Contractor shall comply with Applicable Laws pertaining to the Work and the Contract. Failure to comply with such requirements shall constitute a breach of Contract and shall be grounds for Contract termination. Without limiting the generality of the foregoing, Contractor expressly agrees to comply with the following, as applicable: (i) Title VI and VII of Civil Rights Act of 1964, as amended; (ii) Section 503 and 504 of the Rehabilitation Act of 1973, as amended; (iii) the Health Insurance Portability and Accountability Act of 1996; (iv) the Americans with Disabilities Act of 1990, as amended; (v) ORS Chapter 659; as amended; (vi) ORS Chapter 659A; as amended; (vii) all regulations and administrative rules established pursuant to the foregoing laws; and (vii) all other applicable requirements of federal and state civil rights and rehabilitation statutes, rules and regulations.

B.5.2 Contractor shall comply with all applicable requirements of federal and state civil rights and rehabilitation statutes, rules and regulations, and

(a) Contractor shall not discriminate against Disadvantaged, Minority, Women or Emerging Small Business enterprises, as those terms are defined in ORS 200.005, or a business enterprise that is owned or controlled by or that employs a disabled veteran, as that term is defined in ORS 408.225, in the awarding of subcontracts.

(b) Contractor shall maintain, in current and valid form, all licenses and certificates required by Applicable Laws or this Contract when performing the Work.

B.5.3 Unless contrary to federal law, Contractor shall certify that it shall not accept a bid from Subcontractors to perform Work as described in ORS 701.005 under this Contract unless such Subcontractors are registered with the Construction Contractors Board in accordance with ORS 701.021 to 701.068 at the time they submit their bids to the Contractor.

B.5.4 Unless contrary to federal law, Contractor shall certify that each landscape contractor, as defined in ORS 671.520(2), performing Work under this Contract holds a valid landscape contractor's license issued pursuant to ORS 671.560.

B.5.5 The following notice is applicable to Contractors who perform excavation Work. ATTENTION: Oregon law requires you to follow rules adopted by the Oregon Utility Notification Center. Those rules are set forth in OAR 952-001-0010 through OAR 952-001-00100. You may obtain copies of the rules by calling the center at (503)232-1987.

B.5.6 Failure to comply with any or all of the requirements of B.5.1 through B.5.5 shall be a breach of Contract and constitute grounds for Contract termination. Damages or costs resulting from such noncompliance shall be the responsibility of Contractor.

B.6 SUPERINTENDENCE

Contractor shall keep on the site, during the progress of the Work, a competent superintendent and any necessary assistants who shall be satisfactory to the Owner and who shall represent the Contractor on the site. Directions given to the superintendent by the Owner shall be confirmed in writing to the Contractor.

B.7 INSPECTION

B.7.1 Owner shall have access to the Work at all times.

B.7.2 Inspection of the Work will be made by the Owner at its discretion. The Owner will have authority to reject Work that does not conform to the Contract Documents. Any Work found to be not in conformance with the Contract Documents, in the discretion of the Owner, shall be removed and replaced at the Contractor's expense.

B.7.3 Contractor shall make or obtain at the appropriate time all tests, inspections and approvals of portions of the Work required by the Contract Documents or by Applicable Laws or orders of public authorities having jurisdiction. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work. The Contractor shall give the Owner timely notice of when and where tests and inspections are to be made so that the Owner may be present for such procedures. Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Owner.

B.7.4 As required by the Contract Documents, Work done or material used without required inspection or testing and/or without providing timely notice to the Owner may be ordered removed at the Contractor's expense.

B.7.5 If directed to do so any time before the Work is accepted, the Contractor shall uncover portions of the completed Work for inspection. After inspection, the Contractor shall restore such portions of Work to the standard required by the Contract. If the Work uncovered is unacceptable or was done without required testing or inspection or sufficient notice to the Owner, the uncovering and restoration shall be done at the Contractor's expense. If the Work uncovered is acceptable and was done with sufficient notice to the

Owner, the uncovering and restoration will be paid for pursuant to an Amendment.

B.7.6 If any testing or inspection reveals failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Owner's and Architect/Engineer's services and expenses, shall be at the Contractor's expense.

B.7.7 When the United States government participates in the cost of the Work, or the Owner has an agreement with other public or private organizations, or if any portion of the Work is being performed for a third party or in close proximity to third party facilities, representatives of these organizations shall have the right to inspect the Work affecting their interests or property. Their right to inspect shall not make them a party to the Contract and shall not interfere with the rights of the parties of the Contract. Instructions or orders of such parties shall be transmitted to the Contractor, through the Owner.

B.8 SEVERABILITY

If any provision of this Contract is declared by a court to be illegal or in conflict with any law, the validity of the remaining terms and provisions shall not be affected and the rights and obligations of the parties shall be construed and enforced as if the Contract did not contain the particular provision held to be invalid.

B.9 ACCESS TO RECORDS

B.9.1 Contractor shall keep, at all times on the Work site, one record copy of the complete Contract Documents, including the Plans, Specifications, Construction Change Directives and addenda, in good order and marked currently to record field changes and selections made during construction, and one record copy of

Shop Drawings, Product Data, Samples and similar Submittals, and shall at all times give the Owner access thereto.

B.9.2 Contractor shall retain and the Owner and its duly authorized representatives shall have access, for a period not less than ten (10) years, to all Record Documents, financial and accounting records, and other books, documents, papers and records of Contractor which are pertinent to the Contract, including records pertaining to Overhead and indirect costs, for the purpose of making audit, examination, excerpts and transcripts. If for any reason, any part of the Work or this Contract shall be subject to litigation, Contractor shall retain all such records until all litigation is resolved and Contractor shall continue to provide Owner and/or its agents with full access to such records until such time as all litigation is complete and all periods for appeal have expired and full and final satisfaction of any judgment, order or decree is recorded and Owner receives a record copy of documentation from Contractor.

B.10 WAIVER

Failure of the Owner to enforce any provision of this Contract shall not constitute a waiver or relinquishment by the Owner of the right to such performance in the future nor of the right to enforce any other provision of this Contract.

B.11 SUBCONTRACTS AND ASSIGNMENT

B.11.1 Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound by the terms and conditions of these Public Improvement General Conditions, and to assume toward the Contractor all of the obligations and responsibilities which the Contractor assumes toward the Owner thereunder, unless (1) the same are clearly inapplicable to the subcontract at issue because of legal requirements or industry practices, or (2) specific exceptions are requested by Contractor and approved in writing by Owner. Where appropriate, Contractor shall require each Subcontractor to enter into similar agreements with sub-subcontractors at any level.

B.11.2 At Owner's request, Contractor shall submit to Owner prior to their execution either Contractor's form of subcontract, or the subcontract to be executed with any particular Subcontractor. If Owner disapproves such form, Contractor shall not execute the form until the matters disapproved are resolved to Owner's satisfaction. Owner's review, comment upon or approval of any such form shall not relieve Contractor of its obligations under this Agreement or be deemed a waiver of such obligations of Contractor.

B.11.3 Contractor shall not assign, sell, or transfer its rights, or delegate its responsibilities under this Contract, in whole or in part, without the prior written approval of the Owner. No such written approval shall relieve Contractor of any obligations of this Contract, and any transferee shall be considered the agent of the Contractor and bound to perform in accordance with the Contract Documents. Contractor shall remain liable as between the original parties to the Contract as if no assignment had occurred.

B.12 SUCCESSORS IN INTEREST

The provisions of this Contract shall be binding upon and shall accrue to the benefit of the parties to the Contract and their respective permitted successors and assigns.

B.13 OWNER'S RIGHT TO DO WORK

Owner reserves the right to perform other or additional work at or near the project site with other forces than those of the Contractor. If such work takes place within or next to the project site, Contractor shall coordinate work with the other contractors or forces, cooperate with all other contractors or forces, carry out the Work in a way that will minimize interference and delay for all forces involved, place and dispose of materials being used so as not to interfere with the operations of another, and join the Work with the work of the others in an acceptable manner and perform it in proper sequence to that of the others. The Owner will resolve any disagreements that may arise between or among Contractor and the other contractors over the method or order of doing all work (including the Work). In case of unavoidable interference, the Owner will establish work priority (including the Work) which generally will be in the sequence that the contracts were awarded.

B.14 OTHER CONTRACTS

In all cases and at any time, the Owner has the right to execute other contracts related to or unrelated to the Work of this

Contract. The Contractor of this Contract shall fully cooperate with any and all other contractors without additional cost to the Owner in the manner described in section B.13.

B.15 GOVERNING LAW

This Contract shall be governed by and construed in accordance with the laws of the State of Oregon without regard to principles of conflict of laws.

B.16 LITIGATION

Any Claim between Owner and Contractor that arises from or relates to this Contract and that is not resolved through the Claims Review Process in Section D.3 shall be brought and conducted solely and exclusively within the Circuit Court of Benton County for the State of Oregon; provided, however, if a Claim must be brought in a federal forum, then it shall be brought and conducted solely and exclusively within the United States District Court for the District of Oregon. In no event shall this section be construed as a waiver by the State of Oregon on any form of defense or immunity, whether sovereign immunity, governmental immunity, immunity based on the Eleventh Amendment to the Constitution of the United States or otherwise, from any claim or from the jurisdiction of any court. CONTRACTOR, BY EXECUTION OF THIS CONTRACT, HEREBY CONSENTS TO THE IN PERSONAM JURISDICTION OF THE COURTS REFERENCED IN THIS SECTION B.16.

B.17 ALLOWANCES

B.17.1 The Contractor shall include in the Contract Price all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct.

B.17.2 Unless otherwise provided in the Contract Documents:

(a) when finally reconciled, allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;

(b) Contractor's costs for unloading and handling at the site, labor, installation costs, Overhead, profit and other expenses contemplated for stated allowance amounts shall be included in the Contract Price but not in the allowances;

(c) whenever costs are more than or less than allowances, the Contract Price shall be adjusted accordingly by Amendment. The amount of the Amendment shall reflect (i) the difference between actual costs and the allowances under Section B.17.2(a) and (2) changes in Contractor's costs under Section B.17.2(b).

(d) Unless Owner requests otherwise, Contractor shall provide to Owner a proposed fixed price for any allowance work prior to its performance.

B.18 SUBMITTALS, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

B.18.1 The Contractor shall prepare and keep current, for the Architect's/Engineer's approval (or for the approval of Owner if approval authority has not been delegated to the Architect/Engineer), a schedule and list of Submittals which is coordinated with the Contractor's construction schedule and allows the Architect/Engineer reasonable time to review Submittals. Owner reserves the right to finally approve the schedule and list of Submittals. Submittals include, without limitation, Shop Drawings, product data, and samples which are described below:

(a) Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor (including any sub-subcontractor), manufacturer, supplier or distributor to illustrate some portion of the Work.

(b) Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

(c) Samples are physical examples which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

B.18.2 Shop Drawings, Product Data, Samples and similar Submittals are not Contract Documents. The purpose of their Submittal is to demonstrate for those portions of the Work for which Submittals are required by the Contract Documents the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents. Review of Submittals by the Architect/Engineer is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, or for approval of safety precautions or, unless otherwise specifically stated by the Architect/Engineer, of any construction means, methods, techniques, sequences or procedures, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect/Engineer's review of the Contractor's Submittals shall not relieve the Contractor of its obligations under the Contract Documents. The Architect/Engineer's approval of a specific item shall not indicate approval of an assembly of which the item is a component. Informational Submittals upon which the Architect/Engineer is not expected to take responsive action may be so identified in the Contract Documents. Submittals which are not required by the Contract Documents may be returned by the Architect/Engineer without action.

B.18.3 The Contractor shall review for compliance with the Contract Documents, approve and submit to the Architect/Engineer Shop Drawings, Product Data, Samples and similar Submittals required by the Contract Documents with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of separate contractors. Submittals which are not marked as reviewed for compliance with the Contract Documents and approved by the Contractor may be returned by the Architect/Engineer without action.

B.18.4 Approving and submitting shop drawings, product data, samples and similar Submittals, the Contractor represents that the Contractor has determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and has checked and coordinated the information contained within such Submittals with the requirements of the Work and of the Contract Documents.

B.18.5 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar Submittals until the respective Submittal has been approved by the Architect/Engineer.

B.18.6 The Work shall be in accordance with approved Submittals except that the Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect/Engineer's review or approval of Shop Drawings, Product Data, Samples or similar Submittals unless the Contractor has specifically informed the Architect/Engineer in writing of such deviation at the time of submittal and (i) the Architect/Engineer has given written approval to the specific deviation as a minor change in the Work, or (ii) an Amendment or Construction Change Directive has been executed by Owner authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar Submittals by the Architect/Engineer's review or approval thereof.

B.18.7 In the event that Owner elects not to have the obligations and duties described under this Section B.18 performed by the Architect/Engineer, or in the event no Architect/Engineer is employed by Owner on the project, all obligations and duties assigned to the Architect/Engineer hereunder shall be performed by the Owner.

B.19 SUBSTITUTIONS

The Contractor may make Substitutions only with the written consent of the Owner, after evaluation by the Owner and only in accordance with an Amendment or Construction Change Directive. Substitutions shall be subject to the requirements of the bid documents. By making requests for Substitutions, the Contractor: represents that the Contractor has personally investigated the proposed substitute product; represents that the Contractor will provide the same warranty for the Substitution that the Contractor would for the product originally specified unless approved otherwise; certifies that the cost data presented is complete and includes all related costs under this Contract including redesign costs, and waives all claims for additional costs related to the Substitution which subsequently become apparent; and will coordinate the installation of the accepted Substitution, making such changes as may be required for the Work to be completed in all respects.

B.20 USE OF PLANS AND SPECIFICATIONS

Plans, Specifications and related Contract Documents furnished to Contractor by Owner or Owner's Architect/Engineer shall be used solely for the performance of the Work under this Contract. Contractor and its Subcontractors and suppliers are authorized to use and r e p r o d u c e applicable portions of such documents appropriate to the execution of the Work, but shall not claim any ownership or other interest in them beyond the scope of this Contract, and no such interest shall attach. Unless otherwise indicated, all common law, statutory and terminate the Contract.

B.21 FUNDS AVAILABLE AND AUTHORIZED

If Owner fails to receive funding, appropriations, allocations or other expenditure authority as contemplated by Owner's budget and Owner determines, in its assessment and ranking of the policy objectives explicit or implicit in Owner's budget, Owner may other reserved rights, in addition to copyrights, are retained by Owner.

B.22 NO THIRD PARTY BENEFICIARIES

Owner and Contractor are the only parties to this Contract and are the only parties entitled to enforce its terms. Nothing in this Contract gives, is intended to give, or shall be construed to give or provide any benefit or right, whether directly, indirectly, or otherwise, to third persons unless such third persons are individually identified by name herein and expressly described as intended beneficiaries of the terms of this Contract.

SECTION C
WAGES AND LABOR

C.1 MINIMUM WAGE RATES ON PUBLIC WORKS

Contractor shall comply fully with the provisions of ORS 279C.800 through 279C.870. Documents establishing those conditions, as determined by the Commissioner of the Bureau of Labor and Industries (BOLI), are included as attachments to or are incorporated by reference in the Contract Documents. Pursuant to ORS 279C.830(1)(c), Contractor shall pay workers at not less than the specified minimum hourly rate of wage, and shall include that requirement in all subcontracts. If the Work is subject to both the state prevailing wage rate law and the federal Davis-Bacon Act, Contractor shall pay the higher of the applicable state or federal prevailing rate of wage. Contractor shall provide written notice to all workers of the number of hours per day and days per week such workers may be required to work.

C.2 PAYROLL CERTIFICATION AND FEE REQUIREMENTS

C.2.1 In accordance with ORS 279C.845, the Contractor and every Subcontractor shall submit written certified statements to the Owner, on the form prescribed by the Commissioner of the Bureau of Labor and Industries, certifying the hourly rate of wage paid each worker which the Contractor or the Subcontractor has employed on the project and further certifying that no worker employed on the project has been paid less than the prevailing rate of wage or less than the minimum hourly rate of wage specified in the Contract, which certificate and statement shall be verified by the oath of the Contractor or the Subcontractor that the Contractor or Subcontractor has read the certified statement, that the Contractor or Subcontractor knows the contents of the certified statement, and, that to the Contractor's or Subcontractor's best knowledge and belief, the certified statement is true. The certified statements shall set out accurately and completely the payroll records for the prior week, including the name and address of each worker, the worker's correct classification, rate of pay, daily and weekly number of

hours worked, deductions made, and actual wages paid. Certified statements for each week during which the Contractor or Subcontractor has employed a worker on the project shall be submitted once a month, by the fifth business day of the following month. The Contractor and Subcontractors shall preserve the certified statements for a period of ten (10) years from the date of completion of the Contract.

C.2.2 Pursuant to ORS 279C.845(7), the Owner shall retain 25 percent of any amount earned by the Contractor on this public works project until the Contractor has filed the certified statements required by section C.2.1. The Owner shall pay to the Contractor the amount retained under this subsection within 14 days after the Contractor files the required certified statements, regardless of whether a Subcontractor has failed to file certified statements. Pursuant to ORS 279C.845(8), the Contractor shall retain 25 percent of any amount earned by a first-tier Subcontractor on this public works project until the first-tier Subcontractor has filed with the Owner the certified statements required by C.2.1. Before paying any amount retained under this subsection, the Contractor shall verify that the first-tier Subcontractor has filed the certified statement. Within 14 days after the first-tier Subcontractor files the required certified statement the Contractor shall pay the first-tier Subcontractor any amount retained under this subsection.

C.2.3 In accordance with statutory requirements and administrative rules promulgated by the Commissioner of the Bureau of Labor and Industries, the fee required by ORS 279C.825(1) will be paid by Owner to the Commissioner.

C.3 PROMPT PAYMENT AND CONTRACT CONDITIONS

C.3.1 As a condition to Owner's performance hereunder, the Contractor shall:

C.3.1.1 Make payment promptly, as due, to all persons supplying to Contractor labor or materials for the prosecution of the Work provided for in this Contract.

C.3.1.2 Pay all contributions or amounts due the State Industrial Accident Fund from such Contractor or Subcontractor incurred in the performance of the Contract.

C.3.1.3 Not permit any lien or claim to be filed or prosecuted against the Owner on account of any labor or material furnished. Contractor will not assign any claims that Contractor has against Owner, or assign any sums due by Owner, to Subcontractors, suppliers, or manufacturers, and will not make any agreement or act in any way to give Subcontractors a claim or standing to make a claim against the Owner.

C.3.1.4 Pay to the Department of Revenue all sums withheld from employees pursuant to ORS 316.167.

C.3.2 As a condition to Owner's performance hereunder, if Contractor fails, neglects or refuses to make prompt payment of any claim for labor or services furnished to the Contractor of a Subcontractor by any person in connection with the project as such claim becomes due, the proper officer(s) representing the Owner may pay the claim and charge the amount of the payment against funds due or to become due Contractor under this Contract. Payment of claims in this manner shall not relieve the Contractor or the Contractor's surety from obligation with respect to any unpaid claims.

C.3.3 Contractor shall include in each subcontract for property or services entered into by the Contractor and a first-tier subcontractor, including a material supplier, for the purpose of performing a construction contract, a payment clause that obligates the Contractor to pay the first-tier Subcontractor for satisfactory performance under its subcontract within ten (10) Days out of such amounts as are paid to the Contractor by the public contracting agency under such contract.

C.3.4 All employers, including Contractor, that employ subject workers who work under this contract in the State of Oregon shall comply with ORS 656.017 and provide the required Workers' Compensation coverage, unless such employers are exempt under ORS 656.126. Contractor shall ensure that each of its Subcontractors complies with these requirements.

C.4 PAYMENT FOR MEDICAL CARE

As a condition to Owner's performance hereunder, Contractor shall promptly, as due, make payment to any person, partnership, association or corporation furnishing medical, surgical, and hospital care or other needed care and attention, incident to sickness or injury, to the employees of such Contractor, all sums of which the Contractor agrees to pay for such services and all moneys and sums which the Contractor has collected or deducted from the wages of personnel pursuant to any law, contract or agreement for the purpose of providing or paying for such services.

C.5 HOURS OF LABOR

As a condition to Owner's performance hereunder, no person shall be employed to perform Work under this Contract for more than ten (10) hours in any one day or forty (40) hours in any one week, except in cases of necessity, emergency or where public policy absolutely requires it. In such instances, Contractor shall pay the employee at least time and a half pay:

(a) For all overtime in excess of eight (8) hours a day or forty (40) hours in any one week when the work week is five consecutive Days, Monday through Friday; or

(b) For all overtime in excess of ten (10) hours a day or forty (40) hours in any one week when the work week is four consecutive Days, Monday through Friday; and

(c) For all Work performed on Saturday and on any legal holiday specified in ORS 279C.540.

This section C.5 will not apply to Contractor's Work under this Contract to the extent Contractor is currently a party to a collective bargaining agreement with any labor organization.

This Section C.5 shall not excuse Contractor from completion of the Work within the time required under this Contract.

SECTION D
CHANGES IN THE WORK

D.1 CHANGES IN WORK

D.1.1 The terms of this Contract shall not be waived, altered, modified, supplemented or amended in any manner whatsoever, without prior written agreement and then only after any necessary approvals have been obtained. An Amendment or Change Order is required, which shall not be effective until its execution by the parties to this Contract and all approvals required by public contracting laws have been obtained.

D.1.2 It is mutually agreed that changes in Plans, quantities, or details of construction are inherent in the nature of construction and may be necessary or desirable during the course of construction. Within the general scope of this Contract, the Owner may at any time, without notice to the sureties and without impairing the Contract, require changes consistent with this Section D.1. All changes to the Work shall be documented and Amendments shall be executed under the conditions of the Contract Documents. Such changes may include, but are not limited to:

(a) Modification of specifications and design.
(b) Increases or decreases in quantities.
(c) Increases or decreases to the amount of Work.
(d) Addition or elimination of any Work item.
(e) Change in the duration of the project.
(f) Acceleration or delay in performance of Work.
(g) Deductive changes,
(h) Changed conditions.

Deductive changes are those that reduce the scope of the Work, and shall be made by mutual agreement whenever feasible. In cases of suspension or partial termination under Section J, Owner reserves the right to unilaterally impose a deductive change and to self-perform such Work, for which the provisions of B.13 (Owner's Right to Do Work) shall then apply. Adjustments in compensation shall be made under the provisions of D.1.3, in which costs for deductive changes shall be based upon a Direct Costs adjustment together with the related percentage markup specified for profit, Overhead and other indirect costs, unless otherwise agreed to by Owner.

D.1.3 The Owner and Contractor agree that adjustments to or deletions from the Work shall be administered and compensated according to the following:

(a) Unit pricing may be utilized at the Owner's option when unit prices or solicitation alternates were provided that established the cost for adjustments to Work, and a binding obligation exists under the Contract on the parties covering the terms and conditions of the adjustment to Work.

(b) If the Owner elects not to utilize unit pricing, or in the event that unit pricing is not available or appropriate, fixed pricing may be used for adjustments to or deletions from the Work. In fixed pricing, the basis of payments or total price shall be agreed upon in writing between the parties to the Contract, and shall be established before the Work is done whenever feasible. Notwithstanding the foregoing, the mark-ups set forth in D.1.3(c) shall be utilized in establishing fixed pricing, and such mark-ups shall not be exceeded. Cost and price data relating to adjustments to or deletions from the Work shall be supplied by Contractor to Owner upon request, but Owner shall be under no obligation to make such requests.

(c) In the event that unit pricing and fixed pricing are not utilized, then adjustments to or deletions from the Work shall be performed on a cost reimbursement basis for Direct Costs. Such Work shall be compensated on the basis of the actual, reasonable and allowable cost of labor, equipment, and material furnished on the Work performed. In addition, the following markups shall be added to the Contractor's or Subcontractor's Direct Costs as full compensation for profit, Overhead and other indirect costs for Work directly performed with the Contractor's or Subcontractor's own forces:

On Labor.....	15%
On Equipment.....	10%
On Materials.....	10%

(d) When adjustments to or deletions from the Work under D.1.3(c) are invoiced by an authorized Subcontractor at any level, each ascending tier Subcontractor or Contractor will be allowed a supplemental mark-up on each piece of subcontract Work covered by an Amendment as follows:

$0.00 - $5,000.00	10%,
and then Over $5,000.00	5%

Notwithstanding the foregoing, the maximum aggregate markup to be billed shall not exceed 10% regardless of the number of Subcontract tiers.

Payments made to the Contractor shall be complete compensation for Overhead, profit, and all costs that were incurred by the Contractor or by other forces furnished by the Contractor, including Subcontractors, for adjustments to or deletions from the Work pursuant to an Amendment or Change Order. Owner may establish a maximum cost for additional Work under this Section D.1.3, which shall not be exceeded for reimbursement without additional written authorization from Owner in the form of an Amendment or Change Order. Contractor shall not be required to complete such additional Work without additional authorization.

D.1.4 Any necessary adjustment of Contract Time that may be required as a result of adjustments to or deletions from the Work must be agreed upon by the parties before the start of the revised Work unless Owner authorizes Contractor to start the revised Work before agreement on Contract Time adjustment. Contractor shall submit any request for additional compensation (and additional Contract Time if Contractor was authorized to start Work before an adjustment of Contract Time was approved) as soon as possible but no later than thirty (30) Days after receipt of Owner's request for additional Work. Contractor agrees that this thirty (30) Day notice period is adequate time for it to request and document the amount of additional compensation or adjustment of Contract Time. If Contractor's request for additional compensation or adjustment of Contract Time is not made within the

thirty (30) Day time limit, Contractor agrees its requests pertaining to that additional Work shall be barred. The thirty (30) Day time limit for making requests shall not be extended for any reason, including without limitation Contractor's claimed inability to determine the amount of additional compensation or adjustment of Contract Time, unless an extension is granted in writing by Owner. If the Owner denies Contractor's timely request for additional compensation or adjustment of Contract Time, Contractor may proceed to file a Claim under Section D.3, Claims Review Process. No other reimbursement, compensation, or payment will be made, except as provided in Section D.1.5 for impact claims.

D.1.5 If any adjustment to Work under Section D.1.3 causes an increase or decrease in the Contractor's cost of, or the Contract Time required for the performance of any other part of the Work under this Contract, Contractor shall submit a written request to the Owner, setting forth the nature and specific extent of the request, including all time and cost impacts against the Contract as soon as possible, but no later than thirty (30) Days after receipt of Owner's request for adjustments to or deletions from the Work by Contractor.

The thirty (30) Day time limit applies to claims of Subcontractors, suppliers, or manufacturers who may be affected by Owner's request for adjustments to or deletions from the Work and who request additional compensation or an extension of Contract Time to perform; Contractor has responsibility for contacting its Subcontractors, suppliers, or manufacturers within the thirty (30) Day time limit, and including their requests with Contractor's requests. If the request involves Work to be completed by Subcontractors, or materials to be furnished by suppliers or manufacturers, such requests shall be submitted to the Contractor in writing with full analysis and justification for the adjustments to compensation and Contract Time requested. The Contractor shall analyze and evaluate the merits of the requests submitted by Subcontractors, suppliers, and manufacturers to Contractor prior to including those requests and Contractor's analysis and evaluation of those requests with Contractor's requests for adjustments to compensation or Contract Time that Contractor submits to the Owner. Failure of Subcontractors, suppliers, manufacturers or others to submit their requests to Contractor for inclusion with Contractor's requests submitted to Owner within the time period and by the means described in this section shall constitute a waiver of these Subcontractor claims. The Owner will not consider direct requests or claims from Subcontractors, suppliers, manufacturers or others not a party to this Contract. The consideration of such requests and claims under this section does not give any Person, not a party to the Contract the right to bring a claim against Owner, whether in this claims process, in litigation, or in any dispute resolution process.

If the Owner denies the Contractor's request for adjustment to compensation or Contract Time and the request is timely as set forth herein, the Contractor may proceed to file a Claim under Section D.3, Claims Review Process.

D.1.6 Contractor agrees that no request or Claim for additional costs or an adjustment of Contract Time shall be allowed if made after receipt of Final Payment application under this Contract. Final Payment application must be made by Contractor within the time required under Section E.6.4.

D.1.7 It is understood that changes in the Work are inherent in construction of this type. The number of changes, the scope of those changes, and the effect they have on the progress of the original Work cannot be defined at this time. The Contractor is notified that numerous changes may be required and that there will be no compensation made, unless and only to the extent otherwise provided in the Contract Documents, to the Contractor directly related to the number of changes. Each change will be evaluated for extension of Contract Time and increase or decrease in compensation based on its own merit.

D.2 DELAYS

D.2.1 Delays in construction include "Avoidable Delays", which are defined in Section D.2.1.1, and "Unavoidable Delays", which are defined in Section D.2.1.2. The effect of Avoidable Delays is described in Section D.2.2 and the effect of Unavoidable Delays is described in Section D.2.3.

D.2.1.1 Avoidable Delays include any delays other than Unavoidable Delays, and include delays that otherwise would be considered Unavoidable Delays but that:

(a) Could have been avoided by the exercise of care, prudence, foresight, and diligence on the part of the Contractor or its Subcontractors.

(b) Affect only a portion of the Work and do not necessarily prevent or delay the prosecution of other parts of the Work or the completion of the whole Work within the Contract Time.

(c) Do not impact activities on the accepted CPM Construction Schedule.

(d) Are associated with the reasonable interference of other contractors employed by the Owner that do not necessarily prevent the completion of the whole Work within the Contract Time.

D.2.1.2 Unavoidable Delays include delays other than Avoidable Delays that are:

(a) To the extent caused by any actions of the Owner, or any other employee or agent of the Owner, or by separate contractor employed by the Owner.

(b) To the extent caused by any site conditions that differ materially from what was represented in the Contract Documents or from conditions that would normally be expected to exist and be inherent to the construction activities defined in the Contract Documents. The Contractor agrees to notify the Owner immediately of differing site conditions before the area has been disturbed. The Owner will investigate the area and make a determination as to whether the conditions differ materially from either the conditions stated in the Contract Documents or those that could reasonably be expected in execution of this particular Contract. If Contractor and the Owner agree that a differing site condition exists, any adjustment to compensation or Contract Time will be determined based on the process set forth in Section D.1.5 for adjustments to or deletions from Work. If the Owner disagrees that a differing site

condition exists and denies Contractor's request for additional compensation or Contract Time, Contractor may proceed to file a Claim under Section D.3, Claims Review Process.

(c) To the extent caused by Force Majeure acts, events or occurrences that could not have been avoided by the exercise of care, prudence, foresight, and diligence on the part of the Contractor or its Subcontractors.

(d) To the extent caused by adverse weather conditions. Any adverse weather conditions must be substantiated by documentary evidence that weather conditions were abnormal for the specific time period claimed, could not have been anticipated by the Contractor, and adversely impacted the Project in a manner that could not be avoided by rescheduling the Work or by implementing measures to protect against the weather so that the Work could proceed. A rain, windstorm, high water, or other natural phenomenon for the specific locality of the Work, which might reasonably have been anticipated from the previous 10-year historical records of the general locality of the Work, shall not be construed as abnormal. The parties agree that rainfall greater than the following levels cannot be reasonably anticipated:

(i) Daily rainfall equal to, or greater than, 0.50 inch during a month when the monthly rainfall exceeds the normal monthly average by twenty- five percent (25 %) or more.

(ii) daily rainfall equal to, or greater than, 0.75 inch at any time.

The Office of the Environmental Data Service of the National Oceanic and Atmospheric Administration of the U.S. Department of Commerce nearest the Project site shall be considered the official agency of record for weather information.

D.2.2 Contractor agrees it is not entitled to additional compensation or additional Contract Time for Avoidable Delays.

D.2.3 In the event of Unavoidable Delays, based on principles of equitable adjustment, Contractor may be entitled to the following:

(a) Contractor may be entitled to additional compensation or additional Contract Time, or both, for Unavoidable Delays described in Section D.2.1.2 (a) and (b).

(b) Contractor may be entitled to additional Contract Time for Unavoidable Delays described in Section D.2.1.2(c) and (d).

In the event of any requests for additional compensation or additional Contract Time, or both, as applicable, arising under this Section D.2.3 for Unavoidable Delays, other than requests for additional compensation or additional Contract Time for differing site conditions for which a review process is established under Section D.2.1.2 (b), Contractor must submit a written notification of the delay to the Owner within two (2) Days of the occurrence of the cause of the delay. This written notification shall state the cause of the potential delay, the project components impacted by the delay, and the anticipated additional Contract Time extension or the additional compensation, or both, as applicable, resulting from the delay. Within seven (7) Days after the cause of the delay has been mitigated, or in no case more than thirty (30) Days after the initial written notification, the Contractor agrees to submit to the Owner, a complete and detailed request for additional compensation or additional Contract Time, or both, as applicable, resulting from the delay. If the Owner denies Contractor's request for additional compensation or adjustment of Contract Time, the Contractor may proceed to file a Claim under Section D.3, Claims Review Process, provided Contractor has complied with the requirement in this Section D.2.3. Contractor agrees any Claim it may have is barred if Contractor does not comply with the requirements herein.

If Contractor does not timely submit the notices required under this Section D.2, then unless otherwise prohibited by law, Contractor's Claim shall be barred.

D.3 CLAIMS REVIEW PROCESS

D.3.1 All Contractor Claims shall be referred to the Owner for review. Contractor's Claims, including Claims for adjustments to compensation or Contract Time, shall be submitted in writing by Contractor to the Owner within five (5) Days after a denial of Contractor's initial request for an adjustment of Contract terms, payment of money, extension of Contract Time or other relief, provided that such initial request has been submitted in accordance with the requirements and within the time limits established in these Public Improvement General Conditions.
Within thirty (30) Days after the initial Claim, Contractor shall submit to the Owner a complete and detailed description of the Claim (the "Detailed Notice") that includes all information required by Section D.3.2.
Contractor agrees that, unless the Claim is made in accordance with these time requirements, Contractor voluntarily waived all rights to prosecute its Claim.

D.3.2 The Detailed Notice of the Claim shall be submitted in writing by Contractor and shall include a detailed, factual statement of the basis of the Claim, pertinent dates, Contract provisions which support or allow the Claim, reference to or copies of any documents which support the Claim, the dollar value of the Claim, and the Contract Time adjustment requested for the Claim. If the Claim involves Work to be completed by Subcontractors, the Contractor will analyze and evaluate the merits of the Subcontractor claim prior to forwarding it and that analysis and evaluation to the Owner. The Owner will not consider direct claims from Subcontractors, suppliers, manufacturers, or others not a party to this Contract. Contractor agrees that it will make no agreement, covenant, or assignment, nor will it commit any other act that will permit or assist any Subcontractor, supplier, manufacturer, or other to directly or indirectly make a claim against Owner.

D.3.3 The Owner will review all Claims and take one or more of the following preliminary actions within ten (10) Days of receipt of the Detailed Notice of a Claim: (1) request additional supporting information from the Contractor; (2) inform the Contractor and Owner in writing of the time required for adequate review and response; (3) reject the Claim in whole or in part and identify the reasons for rejection; (4) based on principles of equitable adjustment,

recommend approval of all or part of the Claim; or
(5) propose an alternate resolution.

D.3.4 The Owner's decision shall be final and binding on the Contractor unless appealed by written notice to the Owner within fifteen (15) Days of receipt of the decision. The Contractor must present written documentation supporting the Claim within fifteen (15) Days of the notice of appeal. After receiving the appeal documentation, the Owner shall review the materials and render a decision within thirty (30) Days after receiving the appeal documents.

D.3.5 The decision of the Owner shall be final and binding unless the Contractor delivers to the Owner its request for mediation, which shall be a non-binding process, within fifteen (15) Days of the date of the Owner's decision. The mediation process will be considered to have commenced as of the date the Contractor delivers the request. Both parties acknowledge and agree that participation in mediation is a prerequisite to commencement of litigation of any disputes relating to the Contract. Both parties further agree to exercise their best efforts in good faith to resolve all disputes within sixty (60) Days of the commencement of the mediation through the mediation process set forth herein.

In the event that a lawsuit must be filed within this sixty (60) Day period in order to preserve a cause of action, the parties agree that, notwithstanding the filing, they shall proceed diligently with the mediation to its conclusion prior to actively prosecuting the lawsuit, and shall seek from the Court in which the lawsuit is pending such stays or extensions, including the filing of an answer, as may be necessary to facilitate the mediation process. Further, in the event settlements are reached on any issues through mediation, the plaintiff shall promptly cause to be entered by the Court a stipulated general judgment of dismissal with prejudice, or other appropriate order limiting the scope of litigation as provided in the settlement.

D.3.6 Should the parties arrive at an impasse regarding any Claims or disputed Claims, it is agreed that the parties shall participate in mediation as specified in Section D.3.5. The mediation process will be considered to have been commenced as of the date one party delivers to the other its request in writing to mediate. The mediator shall be an individual mutually acceptable to both parties, but in the absence of agreement each party shall select a temporary mediator and the temporary mediators shall jointly select the permanent mediator. Each party shall pay its own costs for the time and effort involved in mediation. The cost of the mediator shall be split equally between the two parties. Both parties agree to exercise their best effort in good faith to resolve all disputes in mediation. Participation in mediation is a mandatory requirement of both the Owner and the Contractor. The schedule, time and place for mediation will be mutually acceptable, or, failing mutual agreement, shall be as established by the mediator. The parties agree to comply with Owner's administrative rules governing the confidentiality of mediation, if any, and shall execute all necessary documents to give effect to such confidentiality rules. In any event, the parties shall not subpoena the mediator or otherwise require the mediator to produce records, notes or work product, or to testify in any future proceedings as to information disclosed or representations made in the course of mediation, except to the extent disclosure is required by law.

D.3.7 Unless otherwise directed by Owner, Contractor shall proceed with the Work while any Claim, or mediation or litigation arising from a Claim, is pending. Regardless of the review period or the final decision of the Owner, the Contractor shall continue to diligently pursue the Work as identified in the Contract Documents. In no case is the Contractor justified or allowed to cease or Delay Work, in whole or in part, without a written stop work order from the Owner.

SECTION E
PAYMENTS

E.1 SCHEDULE OF VALUES

The Contractor shall submit, at least ten (10) Days prior to submission of its first application for progress payment, a schedule of values ("Schedule of Values") for the contracted Work. This schedule shall provide a breakdown of values for the contracted Work and will be the basis for progress payments. The breakdown shall demonstrate reasonable, identifiable, and measurable components of the Work.
Unless objected to by the Owner, this schedule shall be used as the basis for reviewing Contractor's applications for payment. If objected to by Owner, Contractor shall revise the schedule of values and resubmit the same for approval of Owner.

E.2 APPLICATIONS FOR PAYMENT

E.2.1 Owner shall make progress payments on the Contract monthly as Work progresses, in accordance with the requirements of this Section E.2. Applications for payment shall be based upon estimates of Work completed and the Schedule of Values. As a condition precedent to Owner's obligation to pay, all applications for payment shall be approved by the Owner. A progress payment shall not be considered acceptance or approval of any Work or waiver of any defects therein. Owner shall pay to Contractor interest for overdue invoices at the rate of two- thirds of one percent per month on the progress payment, not including retainage, due the Contractor. Overdue invoices will be those that have not been paid within forty-five (45) days from the latest of:

(a) The date of the receipt of the accurate invoice;
(b) The date Owner receives the correct application for payment if no invoice is received;
(c) The date all goods and services have been received; or
(d) The date a Claim is made certain by agreement of the parties or by operation of law.

Notwithstanding the foregoing, in instances when an application for payment is filled out incorrectly, or when there is any defect or impropriety in any submitted application or when there is a good faith dispute, Owner shall so notify the Contractor within fifteen (15) Days stating the reason or reasons the application for payment is defective or improper or the reasons for the dispute. A defective or improper application for payment, if corrected by the Contractor within seven (7) Days of being notified by the Owner, shall not cause a payment to be made later than specified in this section unless interest is also paid. Payment of interest will be postponed when payment on the principal is delayed because of disagreement between the Owner and the Contractor.

Owner reserves the right, instead of requiring the Contractor to correct or resubmit a defective or improper application for payment, to reject the defective or improper portion of the application for payment and pay the remainder of the application for such amounts which are correct and proper.

Owner, upon written notice to the Contractor, may elect to make payments to the Contractor only by means of Electronic Funds Transfers (EFT) through Automated Clearing House (ACH) payments. If Owner makes this election, the Contractor shall arrange for receipt of the EFT/ACH payments.

E.2.2 .2 Contractor shall submit to the Owner an application for each payment and, if required, receipts or other vouchers showing payments for materials and labor including payments to Subcontractors. Contractor shall include in its application for payment a schedule of the percentages of the various parts of the Work completed, based on the Schedule of Values which shall aggregate to the payment application total, and shall include, on the face of each copy thereof, a certificate in substantially the following form:

"I, the undersigned, hereby certify that the above bill is true and correct, and the payment therefore, has not been received.

Signed: _____
Dated: ",

E.2.3 Generally, applications for payment will be accepted only for materials that have been installed. Under special conditions, applications for payment for stored materials will be accepted at Owner's sole discretion. Such a payment, if made, will be subject to the following conditions:

(a) The request for stored material shall be submitted at least thirty (30) Days in advance of the application for payment on which it appears. Applications for payment shall be entertained for major equipment, components or expenditures only.

(b) The Contractor shall submit applications for payment showing the quantity and cost of the material stored.

(c) The material shall be stored in a bonded warehouse and Owner shall be granted the right to access the material for the purpose of removal or inspection at any time during the Contract Period.

(d) The Contractor shall name the Owner as co-insured on the insurance policy covering the full value of the property while in the care and custody of the Contractor until it is installed. A certificate noting this coverage shall be issued to the Owner.

(e) Payments shall be made for materials and equipment only. The submitted amount in the application for payment shall be reduced by the cost of transportation from the storage site to the project site and for the cost of an inspector to verify delivery and condition of the goods at the storage site. The cost of storage and inspection shall be borne solely by the Contractor.

(f) Within sixty (60) Days of the application for payment, the Contractor shall submit evidence of payment covering the material and/or equipment stored and of payment for the storage site.

(g) Payment for stored materials and/or equipment shall in no way indicate acceptance of the materials and/or equipment or waive any rights under this Contract for the rejection of the Work or materials and/or equipment not in conformance with the Contract Documents.

(h) All required documentation shall be submitted with the respective application for payment.

E.2.4 The Owner reserves the right to withhold all or part of a payment, or may nullify in whole or part any payment previously made, to such extent as may be necessary in the Owner's opinion to protect the Owner from loss because of:

(a) Work that is defective and not remedied, or that has been demonstrated or identified as failing to conform with Applicable Laws or the Contract Documents,

(b) third party claims filed or evidence reasonably indicating that such claims will likely be filed unless security acceptable to the Owner is provided by the Contractor;

(c) failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment (in which case Owner may issue checks made payable jointly to Contractor and such unpaid persons under this provision, or directly to Subcontractors and suppliers at any level under Section C.3.2.);

(d) reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Price;

(e)) damage to the Work, Owner or another contractor;

(f) reasonable evidence that the Work will not be completed within the Contract Time required by the Contract, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay;

(g) failure to carry out the Work in accordance with the Contract Documents; or

(h) assessment of liquidated damages, when withholding is made for offset purposes.

E.2.5 Subject to the provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

(a) Take that portion of the Contract Price properly allocable to completed Work as determined by multiplying the percentage completion of each portion of the Work by the share of the total Contract Price allocated to that portion of the Work in the Schedule of Values, less retainage as provided in Section E.5. Pending final determination of cost to the Owner of changes in the Work, no amounts for changes in the Work can be included in applications for payment until the Contract Price has been adjusted by an Amendment or Change Order;

(b) Add that portion of the Contract Price properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction (or, if approved in advance by the Owner pursuant to Section E.2.3, suitably stored off the site at a location agreed upon in writing), less retainage as provided in Section E.5;

(c) Subtract the aggregate of previous payments made by the Owner; and

(d) Subtract any amounts for which the Owner has withheld or nullified payment as provided in the Contract Documents.

E.2.6 Contractor's applications for payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay to a Subcontractor or material supplier.

E.2.7 The Contractor warrants to Owner that title to all Work covered by an application for payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an application for payment all Work for which payments are received from the Owner shall be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided financing, labor, materials and equipment relating to the Work.

E.2.8 If Contractor disputes any determination by Owner with regard to any application for payment, Contractor nevertheless shall continue to expeditiously perform the Work. No payment made hereunder shall be or be construed to be final acceptance or approval of that portion of the Work to which such partial payment relates or shall relieve Contractor of any of its obligations hereunder.

E.2.9 Contractor shall submit its initial MWESB Report within ten (10) Days of Contractor's execution of the Contract, or if there will be a Guaranteed Maximum Price (GMP) Amendment, then within ten (10) Days of Contractor's execution of the GMP Amendment. Contractor shall submit annual MWESB Reports on June 30 of each year the Contract is active. Contracts (or GMP Amendments) first executed by Contractor within ninety (90) Days before June 30 of the year of execution by Contractor may at the discretion of Owner be exempt from submitting the annual MWESB Report otherwise due on that June 30. The final MWESB Report shall be filed with the application for final payment. Timely receipt of MWESB Reports by Owner shall be a condition precedent to Owner's obligation to pay any progress payments or final payment otherwise due.

E.3 PAYROLL CERTIFICATION REQUIREMENT

Owner's receipt of payroll certification pursuant to Section C.2 of this Contract shall be a condition precedent to Owner's obligation to pay any progress payments or final payment otherwise due.

E.4 DUAL PAYMENT SOURCES

Contractor shall not be compensated for Work performed under this Contract from any state agency other than the agency that is a party to this Contract.

E.5 RETAINAGE

E.5.1 Retainage shall be withheld and released in accordance with the requirements set forth in OSU Standard580-063-0045.

E.5.1.1 Owner may reserve as retainage from any progress payment an amount not to exceed five percent of the payment. As Work progresses, Owner may reduce the amount of retainage on or may eliminate retainage on any remaining monthly Contract payments after 50 percent of the Work under the Contract is completed if, in the Owner's discretion, such Work is progressing satisfactorily. Elimination or reduction of retainage shall be allowed at Owner's sole discretion and only upon written application by the Contractor, which application shall include written approval of Contractor's surety; except that when the Work is 97-1/2 percent completed the Owner may, at its discretion and without application by the Contractor, reduce the retained amount to 100 percent of the value of the Work remaining to be done. Upon receipt of written application by the Contractor, Owner shall respond in writing within a reasonable time.

E.5.1.2 Contractor may request in writing:

(a) to be paid amounts which would otherwise have been retained from progress payments where Contractor has deposited acceptable bonds and securities of equal value with Owner or in a custodial account or other mutually- agreed account satisfactory to Owner, with an approved bank or trust company to be held in lieu of the cash retainage for the benefit of Owner;

(b) for construction projects over $1,000,000, that retainage be deposited in an interest bearing account, established through the State Treasurer for state agencies, in a bank, savings bank, trust company or savings association for the benefit of Owner, with earnings from such account accruing to the Contractor; or

(c) that the Owner allow Contractor to deposit a surety bond for the benefit of Owner, in a form acceptable to Owner, in lieu of all or a portion of funds retained, or to be retained. Such bond and any proceeds therefrom shall be made subject to all claims in the manner and priority as set forth for retainage.

When the Owner has accepted the Contractor's election of option (a) or (b), Owner may recover from Contractor any additional costs incurred through such election by reducing Contractor's final payment. Where the Owner has agreed to Contractor's request for option (c), Contractor shall accept like bonds from Subcontractors and suppliers on the project from which Contractor has required retainages.

E. 5.1.3 The retainage held by Owner shall be included in and paid to the Contractor as part of the Final Payment of the Contract Price. The Owner shall pay to Contractor interest at the rate of two- thirds of one percent per month on the final payment due Contractor, interest to commence forty-five (45) Days after the date which Owner receives Contractor's final approved application

for payment and Work under the Contract has been completed and accepted and to run until the date when final payment is tendered to Contractor. The Contractor shall notify Owner in writing when the Contractor considers the Work complete and deliver to Owner its final application for payment and Owner shall, within fifteen (15) Days after receiving the written notice and the application for payment, either accept the Work or notify the Contractor of Work yet to be performed on the Contract. If Owner does not within the time allowed notify the Contractor of Work yet to be performed to fulfill contractual obligations, the interest provided by this subsection shall commence to run forty-five (45) Days after the end of the 15- Day period.

E.5.1.4 Owner will reduce the amount of the retainage if the Contractor notifies the controller of the Owner that the Contractor has deposited in an escrow account with a bank or trust company, in a manner authorized by the Owner, bonds and securities of equal value of a kind approved by the Owner and such bonds and securities have in fact been deposited.

E.5.1.5 Contractor agrees that if Contractor elects to reserve a retainage from any progress payment due to any Subcontractor or supplier, such retainage shall not exceed five percent of the payment, and such retainage withheld from Subcontractors and suppliers shall be subject to the same terms and conditions stated in Subsection E.5 as apply to Owner's retainage from any progress payment due to Contractor.

E.6 FINAL PAYMENT

E.6.1 Upon completion of all the Work under this Contract, the Contractor shall notify the Owner, in writing, that Contractor has completed Contractor's obligations under the Contract and shall prepare its application requesting final payment. Upon receipt o f such notice and application for payment, the Owner will inspect the Work, and, if acceptable, submit to the Owner a recommendation as to acceptance of the completed Work and the final estimate of the amount due the Contractor. If the Work is not acceptable, Owner will notify Contractor within fifteen (15) Days of Contractor's request for Final Payment. Upon approval of this final application for payment by the Owner and compliance by the Contractor with provisions in Section K, and Contractor's satisfaction of other provisions of the Contract Documents as may be applicable, the Owner shall pay to the Contractor all monies due under the provisions of these Contract Documents.

E.6.2 Neither Final Payment nor any remaining retained percentage shall become due until the Contractor submits to the Owner (1) a certificate evidencing that insurance required by the Contract Documents to remain in force after Final Payment is currently in effect and will not be canceled or allowed to expire until at least thirty (30) Days' prior written notice has been given to the Owner, (2) a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents, (3) consent of surety, if any, to Final Payment and (4), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien. If such lien remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees.

E.6.3 Acceptance of Final Payment by the Contractor, a Subcontractor or material supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final application for payment.

E.6.4 Contractor agrees to submit its final payment application within ninety (90) Days after Substantial Completion, unless written extension is granted by Owner. Contractor shall not delay Final Payment application for any reason, including without limitation nonpayment of Subcontractors, suppliers, manufacturers or others not a party to this Contract, or lack of resolution of a dispute with Owner or any other person of matters arising out of or relating to the Contract. If Contractor fails to submit its Final Payment application within ninety (90) Days after Substantial Completion, and Contractor has not obtained written extension by Owner, all requests or Claims for additional costs or an extension of Contract Time shall be waived.

SECTION F
JOB SITE CONDITIONS

F.1 USE OF PREMISES

Contractor shall confine equipment, storage of materials and operation of Work to the limits indicated by Contract Documents, Applicable Laws, permits or directions of the Owner. Contractor shall follow the Owner's instructions regarding use of premises, if any.

F.2 PROTECTION OF WORKERS, PROPERTY AND THE PUBLIC

F.2.1 Contractor shall maintain continuous and adequate protection of all of the Work from damage and shall protect the Owner, workers and property from injury or loss arising in connection with this Contract. Contractor shall remedy acceptably to the Owner any damage, injury, or loss, except such as may be directly due to errors in the Contract Documents or caused by authorized representatives or personnel of the Owner. Contractor shall adequately protect adjacent property as provided by law and the Contract Documents.

F.2.2 Contractor shall take all necessary precautions for the safety of all personnel on the job site or otherwise engaged in the undertaking of the Work and shall comply with the Contract Documents, best practices and all applicable provisions of federal, state and municipal safety laws and building codes to prevent accidents or injury to persons on, about or adjacent to the premises where the Work is being performed. Contractor shall erect and properly maintain at all times, as required by the conditions and progress of the Work, all necessary safeguards f o r protection of workers and the public against any hazards created by construction. Contractor shall designate a responsible employee or associate on the Work site, whose duty shall be the prevention of accidents. The name and position of the person designated shall be reported to the Owner. The Owner has no responsibility for Work site safety. Work site safety shall be the responsibility of the Contractor.

F.2.3 Contractor shall not enter upon private property without first obtaining permission from the property owner or its duly authorized representative. Contractor shall be responsible for the preservation of all public and private property along and adjacent to the Work contemplated under the Contract and shall use every precaution necessary to prevent damage thereto. In the event the Contractor damages any property, the Contractor shall at once notify the property owner and make, or arrange to make, full restitution. Contractor shall, immediately and in writing, report to the Owner, all pertinent facts relating to such property damage and the ultimate disposition of the claim for damage.

F.2.4 Contractor shall be responsible for protection of adjacent work areas including impacts brought about by activities, equipment, labor, utilities, vehicles and materials on the site.

F.2.5 Contractor shall at all times direct its activities in such a manner as to minimize adverse effects on the environment. Handling of all materials shall be conducted so no release will occur that may pollute or become hazardous.

F.2.6 In an emergency affecting the safety of life or limb or of the Work or of adjoining property, the Contractor, without special instruction or authorization from the Owner, shall act reasonably to prevent threatened loss or injury, and shall so act, without appeal, if instructed by the Owner. Any compensation claimed by the Contractor on account of emergency work shall be determined in accordance with section D.

F.3 CUTTING AND PATCHING

F.3.1 Contractor shall be responsible for coordinating all cutting, fitting, or patching of the Work to make its several parts come together properly and fit to receive or be received by work of other contractors or Subcontractors shown upon, or reasonably implied by, the Contract Documents.

F.3.2 Contractor shall be responsible for restoring all cut, fitted, or patched surfaces to an original condition; provided, however, that if a different condition is specified in the Contract Documents, then Contractor shall be responsible for restoring such surfaces to the condition specified in the Contract Documents.

F.4 CLEANING UP

From time to time as may be prudent or ordered by the Owner and, in any event, immediately after completion of the Work, the Contractor shall, at its own expense, clean up and remove all refuse and unused materials of any kind resulting from the Work. If Contractor fails to do so within twenty-four hours after notification by the Owner the work may be done by others and the cost charged to the Contractor and deducted from payment due the Contractor.

F.5 ENVIRONMENTAL CONTAMINATION

F.5.1. Contractor shall be held responsible for and shall indemnify, defend (with counsel of Owner's choice),and hold harmless Owner from and against any costs, expenses, damages, claims, and causes of action, (including attorneys' fees), or any of them, resulting from all spills, releases, discharges, leaks and disposal of environmental pollution, including storage, transportation, and handling during the performance of the Work or Contractor's obligations under the Contract which occur as a result of, or are contributed by, the negligence or actions of Contractor or its personnel, agents, or Subcontractors or any failure to perform in accordance with the Contract Documents (except to the extent otherwise void under ORS 30.140). Nothing in this section F.5.1 shall limit Contractor's responsibility for obtaining insurance coverages required under Section G.3 of this Contract, and Contractor shall take no action that would void or impair such coverages.

F.5.1.1 Contractor agrees to promptly dispose of such spills, releases, discharge or leaks to the satisfaction of Owner and regulatory agencies having jurisdiction in a manner that complies with Applicable Laws. Cleanup shall be at no cost to the Owner and shall be performed by properly qualified and, if applicable, licensed personnel.

F.5.1.2 Contractor shall obtain the Owner's written consent prior to bringing onto the Work site any (i) environmental pollutants or
(ii) hazardous substances or materials, as the same or reasonably similar terms are used in any Applicable Laws. Notwithstanding such written consent from the Owner, the Contractor, at all times, shall:

(a) properly handle, use and dispose of all environmental pollutants and hazardous substances or materials brought onto the Work site, in accordance with all Applicable Laws;

(b) be responsible for any and all spills, releases, discharges, or leaks of (or from) environmental pollutants or hazardous substances or materials which Contractor has brought onto the Work site; and

(c) promptly clean up and remediate, without cost to the Owner, such spills, releases, discharges, or leaks to the Owner's satisfaction and in compliance with all Applicable Laws.

F.5.2 Contractor shall report all reportable quantity releases, as such releases are defined in Applicable Laws, including but not limited to 40 CFR Part 302, Table 302.4 and in OAR 340-142- 0050, to applicable federal, state, and local regulatory and emergency response agencies. Upon discovery, regardless of quantity, Contractor must telephonically report all releases to the Owner. A written follow-up report shall be submitted to Owner within 48 hours of the telephonic report. Such written report shall contain, as a minimum:

(a) Description of items released (identity, quantity, manifest numbers, and any and all other documentation required by law.)

(b) Whether amount of items released is EPA/DEQ reportable, and, if so, when reported.

(c) Exact time and location of release, including a description of the area involved.

(d) Containment procedures initiated.

(e) Summary of communications about the release between Contractor and members of the press or Stat, local or federal officials other than

Owner.

(f) Description of cleanup procedures employed or to be employed at the site, including disposal location of spill residue.

(g) Personal injuries, if any, resulting from, or aggravated by, the release.

F.6 ENVIRONMENTAL CLEAN-UP

F.6.1 Unless disposition of environmental pollution is specifically a part of this Contract, or was caused by the Contractor (reference F.5 Environmental Contamination), Contractor shall immediately notify Owner of any hazardous substance(s) which Contractor discovers or encounters during performance of the Work required by this Contract. "Hazardous substance(s)" means any hazardous, toxic and radioactive materials and those substances defined as "hazardous substances," "hazardous materials," "hazardous wastes," "toxic substances," or other similar designations in any federal, state, or local law, regulation, or ordinance, including without limitation asbestos, polychlorinated biphenyl (PCB), or petroleum, and any substances, materials or wastes regulated by 40 CFR, Part 261 and defined as hazardous in 40 CFR S 261.3. In addition to notifying Owner of any hazardous substance(s) discovered or encountered, Contractor shall immediately cease working in any particular area of the project where a hazardous substance(s) has been discovered or encountered if continued work in such area would present a risk or danger to the health or well-being of Contractor's or any Subcontractor's work force, property or the environment.

F.6.2 Upon being notified by Contractor of the presence of hazardous substance(s) on the project site, Owner shall arrange for the proper disposition of such hazardous substance(s).

F.7 FORCE MAJEURE

A party to this Contract shall not be held responsible for delay or default due to Force Majeure acts, events or occurrences unless they could have been avoided by the exercise of reasonable care, prudence, foresight, and diligence by that party. The Owner may terminate this Contract upon written notice after determining that delay or default caused by Force Majeure acts, events or occurrences will reasonably prevent successful performance of the Contract.

SECTION G INDEMNITY, BONDING, AND INSURANCE

G.1 RESPONSIBILITY FOR DAMAGES / INDEMNITY

G.1.1 Contractor shall be responsible for all damage to property, injury to persons, and loss, expense, inconvenience, and delay that may be caused by, or result from, the carrying out of the Work to be done under this Contract, or from any act, omission or neglect of the Contractor, its Subcontractors, sub-subcontractors of any tier, suppliers, employees, guests, visitors, invitees and agents.

G.1.2 To the fullest extent permitted by law, Contractor shall indemnify, defend (with counsel approved by Owner) and hold harmless the Owner, Architect/Engineer, Architect/Engineer's consultants, and their respective officers, directors, agents, employees, partners, members, stockholders and affiliated companies (collectively "Indemnitees") from and against all liabilities, damages, losses, claims, expenses (including reasonable attorney fees), demands and actions of any nature whatsoever which arise out of, result from or are related to, (a) any damage, injury, loss, expense, inconvenience or delay described in this Section G.1., (b) any accident or occurrence which happens or is alleged to have happened in or about the project site or any place where the Work is being performed, or in the vicinity of either, at any time prior to the time the Work is fully completed in all respects, (c) any failure of the Contractor or its Subcontractors, sub-subcontractors of any tier, suppliers, employees, or consultants to observe or perform any duty or obligation under the Contract Documents which is to be observed or performed by the Contractor, or any breach of any agreement, representation or warranty of the Contractor contained in the Contract Documents or in any subcontract, (d) the negligent acts or omissions of the Contractor, a Subcontractor, sub-subcontractor of any tier, a supplier, a consultant, or anyone directly or indirectly employed by them or any one of them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder (except to the extent otherwise void under ORS 30.140), and (e) any lien filed upon the project or bond claim in connection with the Work. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Section G.1.2.

G.1.3 In claims against any person or entity indemnified under Section G.1.2 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under Section G.1.2 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

G.2 PERFORMANCE AND PAYMENT SECURITY; PUBLIC WORKS BOND

G.2.1 When the Contract Price is $100,000 or more (or $50,000 or more in the case of Contracts for highways, bridges and other transportation projects), the Contractor shall furnish and maintain in effect at all times during the Contract Period a performance bond in a sum equal to the Contract Price and a separate payment bond also in a sum equal to the Contract Price. Contractor shall furnish such bonds even if the Contract Price is less than the above thresholds if otherwise required by the Contract Documents.

G.2.2 Bond forms furnished by the Owner and notarized by awarded Contractor's surety company authorized to do business in Oregon are the only acceptable forms of performance and payment security, unless otherwise specified in the Contract Documents.

G.2.3 Before execution of the Contract the Contractor shall file with the Construction Contractors Board, and maintain in full force and effect, the separate public works bond required by Oregon Laws 2015, Chapter 279C, and OAR 839-025-0015, unless otherwise exempt under those provisions. The Contractor shall also include in every subcontract a provision requiring the Subcontractor to have a public works bond filed with the

Construction Contractors Board before starting Work, unless otherwise exempt, and shall verify that the Subcontractor has filed a public works bond before permitting any Subcontractor to start Work.

G.3 INSURANCE

G.3.1 Primary Coverage: Insurance carried by Contractor and Subcontractors under this Contract shall be the primary coverage. The coverages indicated are minimums unless otherwise specified in the Contract Documents.

G.3.2 Workers' Compensation: All employers, including Contractor, that employ subject workers who work under this Contract in the State of Oregon shall comply with ORS 656.017 and provide the required Workers' Compensation coverage, unless such employers are exempt under ORS 656.126. This shall include Employer's Liability Insurance with coverage limits of not less than the minimum amount required by statute for each accident. Contractors who perform the Work without the assistance or labor of any employee need not obtain such coverage if the Contractor certifies so in writing. Contractor shall ensure that each of its Subcontractors complies with these requirements. The Contractor shall require proof of such Workers' Compensation coverage by receiving and keeping on file a certificate of insurance from each Subcontractor or anyone else directly employed by either the Contractor or its Subcontractors.

G.3.3 Builder's Risk Insurance:

G.3.3.1 Builder's Risk: During the term of this Contract, for new construction the Contractor shall obtain and keep in effect Builder's Risk insurance on an all risk forms, including earthquake and flood, for an amount equal to the full amount of the Contract, plus any changes in values due to modifications, Change Orders and loss of materials added. Such Builder's Risk shall include, in addition to earthquake and flood, theft, vandalism, mischief, collapse, transit, debris removal, and architect's fees "soft costs" associated with delay of project due to insured peril. Any deductible shall not exceed $50,000 for each loss, except the earthquake and flood deductible which shall not exceed 2 percent of each loss or $50,000, whichever is greater. The deductible shall be paid by Contractor if Contractor or its Subcontractors are negligent. The policy will include as loss payees Owner, the Contractor and its Subcontractors as their interests may appear.

G.3.3.2 Builder's Risk Installation Floater: For Work other than new construction, Contractor shall obtain and keep in effect during the term of this Contract, a Builder's Risk Installation Floater for coverage of the Contractor's labor, materials and equipment to be used for completion of the Work performed under this Contract. The minimum amount of coverage to be carried shall be equal to the full amount of the Contract. The policy will include as loss payees Owner, the Contractor and its Subcontractors as their interests may appear. Owner may waive this requirement at their sole and absolute discretion.

G.3.3.3 Such insurance shall be maintained until Owner has occupied the facility.

G.3.3.4 Loss insured under the Builder's Risk insurance shall be adjusted by the Owner and made payable to the Owner as loss payee. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and

by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their sub-subcontractors of any tier in similar manner. The Owner shall have power to adjust and settle a loss with insurers.

G.3.4 General Liability Insurance:

G.3.4.1 Commercial General Liability: Upon issuance of a Contract, Contractor shall obtain, and keep in effect at Contractor's expense for the term of the Contract, Commercial General Liability Insurance covering bodily injury and property damage in the amount of $1,000,000 per claim and $2,000,000 per occurrence in a form satisfactory to Owner. This insurance shall include personal injury liability, products and completed operations, no subcontractors' limitations, and blanket contractual liability coverage for the indemnities provided under this Contract (to the extent contractual liability coverage for the indemnity is available in the marketplace), and shall be issued on an occurrence basis.

G.3.4.2 Automobile Liability: Contractor shall obtain, at Contractor's expense, and keep in effect during the term of this Contract, Automobile Liability Insurance covering owned, and/or hired vehicles, as applicable. The coverage may be written in combination with the Commercial General Liability Insurance. Contractor shall provide proof of insurance of not less than $1,000,000 per claim and $2,000,000 per occurrence. Contractor and its Subcontractors shall be responsible for ensuring that all non-owned vehicles maintain adequate Automobile Liability insurance while on site.

G.3.4.3 Owner may adjust the insurance amounts required in Section
G.3.4.1 and G.3.4.2 based upon institution specific risk assessments through the issuance of Supplemental General Conditions and a Contract.

G.3.4.4 "Tail" Coverage: If any of the required liability insurance is arranged on a "claims made" basis, "tail" coverage will be required at the completion of this Contract for a duration of 36 months or the maximum time period available in the marketplace if less than 36 months. Contractor shall furnish certification of "tail" coverage as described or continuous "claims made" liability coverage for 36 months following Final Completion. Continuous "claims made" coverage will be acceptable in lieu of "tail" coverage, provided its retroactive date is on or before the effective date of this Contract. Owner's receipt of the policy endorsement evidencing such coverage shall be a condition precedent to Owner's obligation to make final payment and to Owner's final acceptance of Work or services and related warranty (if any).

G.3.4.5: Umbrella Liability: Contractor shall obtain, at Contractor's expense, and keep in effect during the term of this Contract, Umbrella liability Insurance over and above the general liability, automobile liability and workers' compensation coverage if required by Owner in specified limits at time of requirement.

G.3.4.6 Pollution Liability (if required by Owner through issuance of Supplemental General Conditions): Contractor shall obtain, at Contractor's expense, and

keep in effect during the term of this Contract, Pollution liability Insurance in minimum amounts of $3,000,000 naming Owner as "additional insured," as noted in the "additional insured section below.

G.3.5 Additional Insured: The general liability insurance coverage, professional liability, umbrella, and pollution liability if required, shall include the Owner as additional insureds but only with respect to the Contractor's activities to be performed under this Contract, and shall include completed operations coverage.

If Contractor cannot obtain an insurer to name the Owner as additional insureds, Contractor shall obtain at Contractor's expense, and keep in effect during the term of this Contract, Owners and Contractors Protective Liability Insurance, naming the Owner as additional insureds with not less than a $2,000,000 limit per occurrence. This policy must be kept in effect for at least 36 months following Final Completion. As evidence of coverage, Contractor shall furnish the actual policy to Owner prior to execution of the Contract.

G.3.6 Notice of Cancellation or Change: If the Contractor receives a non-renewal or cancellation notice from an insurance carrier affording coverage required herein, or receives notice that coverage no longer complies with the insurance requirements herein, Contractor agrees to notify Owner by fax within five (5) business days with a copy of the non-renewal or cancellation notice, or written specifics as to which coverage is no longer in compliance. When notified by Owner, the Contractor agrees to stop Work pursuant to this Contract, unless all required insurance remain in effect. Any failure to comply with the reporting provisions of this insurance, except for the potential exhaustion of aggregate limits, shall not affect the coverages provided to the Owner and its institutions, divisions, officers, and employees.

Owner shall have the right, but not the obligation, of prohibiting Contractor from entering the Work site until a new certificate(s) of insurance is provided to Owner evidencing the replacement coverage. The Contractor agrees Owner reserves the right to withhold payment to Contract until evidence of reinstated or replacement coverage is provided to Owner.

G.3.7 Certificate(s) of Insurance: As evidence of the insurance coverage required by this Contract, the Contractor shall furnish certificate(s) of insurance to the Owner prior to execution of the Contract. The certificate(s) will specify all of the parties who are additional insureds or loss payees for this contract. Insurance coverage required under this Contract shall be obtained from insurance companies or entities acceptable to the Owner and that are eligible to provide such insurance under Oregon law. Eligible insurers include admitted insurers that have been issued a certificate of authority from the Oregon Department of Consumer and Business Services authorizing them to conduct an insurance business and issue policies of insurance in the state of Oregon, and certain non-admitted surplus lines insurers that satisfy the requirements of applicable Oregon law and which are subject to approval by the Owner. The Contractor shall be financially responsible for all deductibles, self-insured retentions and/or self-insurance included hereunder. Any deductible, self-insured retention and/or self-insurance in excess of $50,000 shall be subject to approval by the Owner in writing and shall be a condition precedent to the effectiveness of any Contract. The Owner has the right to require the Contractor at any time during the performance of the Work to furnish to Owner copies of the Contractor's actual policies.

SECTION H
SCHEDULE OF WORK

H.1 CONTRACT PERIOD

H.1.1 Time is of the essence. The Contractor shall at all times carry on the Work diligently, without delay and punctually fulfill all requirements herein. If required by the Contract Documents, Contractor shall commence Work on the site within fifteen (15) Days of Notice to Proceed, unless directed otherwise.

H.1.2 Unless specifically extended by an Amendment or Change Order, all Work shall be complete by the date contained in the Contract Documents. The Owner shall have the right to accelerate the completion date of the Work, which may require the use of overtime. Such accelerated Work schedule shall be an acceleration in performance of Work under Section D.1.2 (f) and shall be subject to the provisions of Section D.1.

H.1.3 The Owner shall not waive any rights under the Contract by permitting the Contractor to continue or complete in whole or in part the Work after the date described in Section H.1.2 above.

H.2 SCHEDULE

H.2.1 Contractor shall provide, by or before the pre-construction conference, the initial as-planned Construction Schedule for review and acceptance by the Owner. The submitted Construction Schedule must illustrate Work by project components, labor trades, and long lead items broken down by building and/or floor where applicable. If Owner shall so elect, Contractor shall provide the Construction Schedule in CPM format showing the graphical network of planned activities, including i) a reasonably detailed list of all activities required to complete the Work; ii) the time and duration that each activity will take to completion; and iii) the dependencies between the activities. Construction Schedules lacking adequate detail, or unreasonably detailed, will be rejected. The Construction Schedule shall include the following: Notice to Proceed or the date the Work commences, if no Notice to Proceed is issued by Owner, Substantial Completion, and Final Completion. Construction Schedules shall be updated monthly, unless otherwise required by the Contract Documents, and submitted with the monthly application for payment. Acceptance of the Construction Schedule by the Owner does not constitute agreement by the Owner as to the Contractor's sequencing, means, methods, or durations. Any positive difference between the Contractor's scheduled completion and the Contract completion date is float owned by the Owner. Owner reserves the right to negotiate the float if it is deemed to be in Owner's best interest to do so. In no case shall the Contractor make a claim for delays if the Work is completed within the Contract Time but after Contractor's scheduled completion.

H.3 PARTIAL OCCUPANCY OR USE

H.3.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage, provided such occupancy or use is consented to by public authorities having jurisdiction over the Work. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have reasonably accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, insurance or self-insurance, maintenance, heat, utilities, and damage to the Work, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents with respect to such portion of the Work. Approval by the Contractor to partial occupancy or use shall not be unreasonably withheld. Immediately prior to such partial occupancy or use, the Owner and Contractor shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work. Partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

SECTION I
CORRECTION OF WORK

I.1 CORRECTION OF WORK BEFORE FINAL PAYMENT

The Contractor warrants to the Owner that materials and equipment furnished under the Contract will be of good quality and new unless otherwise required or permitted by the Contract Documents, that the Work will be free from defects, and that the Work will conform to the requirements of the Contract Documents. Work failing to conform to these requirements shall be deemed defective. Contractor shall promptly remove from the premises and replace all defective materials and equipment as determined by the Owner, whether incorporated in the Work or not. Removal and replacement shall be without loss or expense to the Owner, and Contractor shall bear the cost of repairing all Work destroyed or damaged by such removal or replacement. Contractor shall be allowed a period of no longer than thirty (30) Days after Substantial Completion for completion of defective (Punch List) work. At the end of the thirty-day period, or earlier if requested by the Contractor, Owner shall arrange for inspection of the Work by the Architect/Engineer. Should the work not be complete, and all corrections made, the costs for all subsequent re-inspections shall be borne by the Contractor. If Contractor fails to complete the Punch List work within the thirty (30) Day period, Owner may perform such work and Contractor shall reimburse Owner all costs of the same within ten (10) Days after demand without affecting Contractor's obligations.

I.2 WARRANTY WORK

I.2.1 Neither the final certificate of payment nor any provision of the Contract Documents shall relieve the Contractor from responsibility for defective Work and, unless a longer period is specified, Contractor shall correct all defects that appear in the Work within a period of one year from the date of issuance of the written notice of Substantial Completion by the Owner except for latent defects which will be remedied by the Contractor at any time they become apparent. The Owner shall give Contractor notice of defects with reasonable promptness. The Contractor shall perform the warranty Work by correcting defects within twenty-four (24) hours of notification by Owner, unless otherwise specified in the Contract Documents. Should the Contractor fail to respond within the specified response time, the Owner may, at its option, complete the necessary repairs using another contractor or its own forces. If Owner completes the repairs using Owner's own forces, Contractor shall pay Owner at the rate of one and one-half (1½) times the standard hourly rate of Owner's forces, plus related overhead and any direct non-salary costs. If Owner completes the repairs using another contractor, Contractor shall pay Owner the amount of Owner's direct costs billed by the other contractor for the work, plus the direct salary costs and related overhead and direct non-salary expenses of Owner's forces who are required to monitor that contractor's work. Work performed by Owner using Owner's own forces or those of another contractor shall not affect the Contractor's contractual duties under these provisions, including warranty provisions. In the event of warranty work consisting of emergency repairs, Owner may perform such work and Contractor shall reimburse Owner all costs of the same within ten (10) Days after demand, without affecting Contractor's obligations.

I.2.2 Nothing in this Section I.2 provision shall negate guarantees or warranties for periods longer than one year including without limitation such guarantees or warranties required by other sections of the Contract Documents for specific installations, materials, processes, equipment or fixtures.

I.2.3 In addition to Contractor's warranty, manufacturer's warranties shall pass to the Owner and shall not take effect until such portion of the Work covered by the applicable warranty has been accepted in writing by the Owner.

I.2.4 The one-year period for correction of Work shall be extended with respect to portions of Work performed after Substantial Completion by the period of time between Substantial Completion and the actual performance of the Work, and shall be extended by corrective Work performed by the Contractor pursuant to this Section, as to the Work corrected. The Contractor shall remove from the site portions of the Work which are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

I.2.5 Nothing contained in this Section I.2 shall be construed to establish a period of limitation with respect to other obligations which the Contractor might have under the Contract Documents. Establishment of the period for correction of Work as described in this Section I.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

I.2.6 If the Owner prefers to accept Work which is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Price will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

SECTION J
SUSPENSION AND/OR TERMINATION OF THE WORK

J.1 OWNER'S RIGHT TO SUSPEND THE WORK

J.1.1 The Owner has the authority to suspend portions or all of the Work due to the following causes:

(a) Failure of the Contractor to correct unsafe conditions;

(b) Failure of the Contractor to carry out any provision of the Contract;

(c) Failure of the Contractor to carry out orders;

(d) Conditions, in the opinion of the Owner, which are unsuitable for performing the Work;

(e) Time required to investigate differing site conditions;

(f) Any reason considered to be in the public interest.

J.1.2 The Owner shall notify Contractor and the Contractor's Surety in writing of the effective date and time of the suspension, and Owner shall notify Contractor and Contractor's surety in writing to resume Work.

J.2 CONTRACTOR'S RESPONSIBILITIES

J.2.1 During the period of the suspension, Contractor is responsible to continue maintenance at the project just as if the Work were in progress. This includes, but is not limited to, protection of completed Work, maintenance of access, protection of stored materials, temporary facilities, and clean-up.

J.2.2 When the Work is recommenced after the suspension, the Contractor shall replace or renew any Work damaged during the suspension, remove any materials or facilities used as part of temporary maintenance, and complete the project in every respect as though its prosecution had been continuous and without suspension.

J.2.3 **COMPENSATION FOR SUSPENSION**

J.2.4

J.2.1 Depending on the reason for suspension of the Work, the Contractor or the Owner may be due compensation by the other party. If the suspension was required due to acts or omissions of Contractor, the Owner may assess the Contractor actual costs of the suspension in terms of administration, remedial work by the Owner's forces or another contractor to correct the problem associated with the suspension, rent of temporary facilities, and other actual costs related to the suspension. If the suspension was caused by acts or omissions of the Owner, the Contractor may be due compensation which shall be defined using Section D, Changes in Work. If the suspension was required through no fault of the Contractor or the Owner, neither party shall owe the other for the impact.

J.4 OWNER'S RIGHT TO TERMINATE CONTRACT

J.4.1 The Owner may, without prejudice to any other right or remedy, and after giving Contractor seven (7) Days' written notice and an opportunity to cure, terminate the Contract in whole or in part under the following conditions:

(a) If Contractor should, voluntarily or involuntarily, seek protection under the United States Bankruptcy Code and Contractor as debtor-in-possession or the Trustee for the estate fails to assume the Contract within a reasonable time;

(b) If Contractor should make a general assignment for the benefit of Contractor's creditors;

(c) If a receiver should be appointed on account of Contractor's insolvency;

(d) If Contractor should repeatedly refuse or fail to supply an adequate number of skilled workers or proper materials to carry on the Work as required by the Contract Documents, or otherwise fail to perform the Work in a timely manner;

(e) If Contractor should repeatedly fail to make prompt payment to Subcontractors or for material or labor, or should disregard laws, ordinances or the instructions of the Owner; or

(f) If Contractor is otherwise in breach of any part of the Contract.

(g) If Contractor is in violation of Applicable Laws, either in the conduct of its business or in its performance of the Work.

J.4.2 At any time that any of the above occurs, Owner may exercise all rights and remedies available to Owner at law or in equity, and, in addition, Owner may take possession of the premises and of all materials and appliances and finish the Work by whatever method it may deem expedient. In such case, the Contractor shall not be entitled to receive further payment until the Work is completed. If the Owner's cost of finishing the Work exceeds the unpaid balance of the Contract Price, Contractor shall pay the difference to the Owner.

J.5 TERMINATION FOR CONVENIENCE

J.5.1 Owner may terminate the Contract in whole or in part whenever Owner determines that termination of the Contract is in the best interest of Owner or the public.

The Owner shall provide the Contractor with seven (7) Days prior written notice of a termination for Owner's or for public convenience. After such notice, the Contractor shall provide the Owner with immediate and peaceful possession of the premises and materials located on and off the premises for which the Contractor received progress payment under Section E. Compensation for Work terminated by the Owner under this provision will be according to Section E. In no circumstance shall Contractor be entitled to lost profits for Work not performed due to termination.

J.6 ACTION UPON TERMINATION

J.6.1 Upon receiving a notice of termination, and except as directed otherwise by the Owner, Contractor shall immediately cease placing further subcontracts or orders for materials, services, or facilities. In addition, Contractor shall terminate all subcontracts or orders to the extent they

relate to the Work terminated and, with the prior written approval of the Owner, settle all outstanding liabilities and termination settlement proposals arising from the termination of subcontracts and orders.

J.6.2 As directed by the Owner, Contractor shall, upon termination, transfer title and deliver to the Owner all Record Documents, information, and other property that, if the Contract had been completed, would have been required to be furnished to the Owner.

I.6.3 Upon Owner's notice of termination pursuant to either Section
J.4 or J.5, if Owner shall so elect, Contractor shall assign the Owner such subcontracts and orders as Owner shall specify. In the event Owner elects to take assignment of any such subcontract or order, Contractor shall take such action and shall execute such documents as Owner shall reasonably require for the effectiveness of such assignment and Contractor shall ensure that no contractual arrangement between it and its subcontractors or suppliers of any tier or sub-tier shall prevent such assignment.

SECTION K
CONTRACT CLOSE OUT

K.1 RECORD DOCUMENTS

As a condition of final payment (refer also to section E.6), Contractor shall comply with the following: Contractor shall provide Record Documents for the entire project to Owner. Record Documents shall depict the project as constructed and shall reflect each and every change, modification, and deletion made during the construction. Record Documents are part of the Work and shall be provided prior to the Owner's issuance of final payment. Record Documents include all modifications to the Contract Documents unless otherwise directed, and accurate MWESB Reports.

K.2 OPERATION AND MAINTENANCE MANUALS

As part of the Work, Contractor shall submit two completed operation and maintenance manuals ("O & M Manuals") for review by the Owner prior to submission of any pay request for more than 75% of the Work. Owner's receipt of the O & M Manuals shall be a condition precedent to any payment thereafter due. The O & M Manuals shall contain a complete set of all Submittals, all product data as required by the specifications, training information, telephone list and contact information for all consultants, manufacturers, installer and suppliers, manufacturer's printed data, record and shop drawings, schematic diagrams of systems, appropriate equipment indices, warranties and bonds. The Owner shall review and return one O & M Manual for any modifications or adjustments required. Prior to submission of its final pay request, Contractor shall deliver two (2) complete and approved sets of O & M Manuals in paper form and one (1) complete and approved set in electronic form to the Owner and Owner's receipt of the O & M Manuals shall be a condition precedent to Owner's obligation to make final payment.

K.3 COMPLETION NOTICES

K.3.1 Contractor shall provide Owner written notice of both Substantial and Final Completion. The certificate of Substantial Completion shall state the date of Substantial Completion, the responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and the time within which the Contractor shall finish all items on the Punch List accompanying the Certificate. Both completion notices must be signed by the Contractor and the Owner to be valid. The Owner shall provide the final signature on the notices. The notices shall take effect on the date they are signed by the Owner.

K.3.2 Substantial Completion of a facility with operating systems (e.g., mechanical, electrical, HVAC) shall be that degree of completion that has provided a minimum of thirty (30) continuous Days of successful, trouble-free operation, which period shall begin after all performance and acceptance testing has been successfully demonstrated to the Owner. All equipment contained in the Work, plus all other components necessary to enable the Owner to operate the facility in the manner that was intended, shall be complete on the Substantial Completion date. The Contractor may request that a Punch List be prepared by the Owner with submission of the request for the Substantial Completion notice.

K.4 TRAINING

As part of the Work, and prior to submission of the final application for payment, the Contractor shall schedule with the Owner training sessions for all equipment and systems as required by the Contract Documents. Contractor shall schedule training sessions at least two weeks in advance of the date of training to allow Owner to provide its personnel with adequate notice. The O & M Manual shall be used as a basis for training. In addition to any off-site training required by the Contract Documents, training shall include a formal session conducted at the Work site after the equipment and/or system is completely installed and operational in its normal operating environment.

K.5 EXTRA MATERIALS

As part of the Work, Contractor shall provide spare parts, extra maintenance materials, and other materials or products in the quantities specified in the Contract Documents prior to final payment. Delivery point for extra materials shall be designated by the Owner.

K.6 ENVIRONMENTAL CLEAN-UP

As part of the Final Completion notice, or as a separate written notice submitted with or before the notice of Final Completion, the Contractor shall notify the Owner that all environmental and pollution clean-up, remediation and closure have been completed in accordance with all Applicable Laws and pursuant to the authority of all agencies having jurisdiction, and Contractor shall provide Owner with any and all documentation related to the same, including but not limited to directives, orders, letters, certificates and permits related to or arising from such environmental pollution. The notice shall reaffirm the indemnification given under Section F.5.1 above. Contractor's completion of its obligations under this Section K.6 and Owner's receipt of documents evidencing such completion shall be a condition precedent to Owner's obligation to make final payment.

K.7 CERTIFICATE OF OCCUPANCY

Owner's receipt of an unconditioned certificate of occupancy from the appropriate state and/or local building officials shall be a condition precedent to Owner's obligation to make final payment, except to the extent failure to obtain an unconditional certificate of occupancy is due to the sole fault or neglect of Owner.

K.8 OTHER CONTRACTOR RESPONSIBILITIES

The Contractor shall be responsible for returning to the

Owner all property of Owner issued to Contractor during construction such as keys, security passes, site admittance badges, and all other pertinent items. Upon notice from Owner, Contractor shall be responsible for notifying the appropriate utility companies to transfer utility charges from the Contractor to the Owner. The utility transfer date shall not be before Substantial Completion and may not be until Final Completion, if the Owner does not take beneficial use of the facility and the Contractor's forces continue with the Work.

K.9 SURVIVAL

All warranty and indemnification provisions of this Contract, and all of Contractor's other obligations under this Contract that are not fully performed by the time of Final Completion or termination, shall survive Final Completion or any termination of the Contract.

OREGON STATE UNIVERSITY

SUPPLEMENTAL GENERAL CONDITIONS

To The

PUBLIC IMPROVEMENT GENERAL CONDITIONS

Project Name: SPORTS PERFORMANCE CENTER WEIGHT ROOM REFRESH

The following modify the June 30, 2017 Oregon State University General Conditions ("OSU Public Improvement General Conditions") for this Contract. Where a portion of the OSU General Conditions is modified by these Supplemental General Conditions, the unaltered portions shall remain in effect.

SG-1 Section B.4 is modified as follows: Revise to read:

"Contractor shall obtain and pay for all necessary permits and licenses, except for those specifically excluded in the Supplemental General Conditions, for the construction of the Work, for temporary obstructions, enclosures, opening of streets for pipes, walls, utilities, environmental Work, etc., as required for the project. Owner shall obtain and pay for the general building permit and pay for any specialty permits required for the Work. Contractor shall be responsible for all violations of the law, in connection with the construction or caused by obstructing streets, sidewalks or otherwise. Contractor shall give all requisite notices to public authorities. The Contractor shall pay all royalties and license fees. The Contractor shall defend all suits or claims for infringement of any patent or other proprietary rights and save harmless and blameless from loss, on account thereof, Oregon State University, and its departments, divisions, members and employees.

SG-2 Section F.2.4 is modified as follows: Add the following:

"Contractor shall verify that all mechanical or electrical equipment in the construction areas that may be affected by the Work is in working order and shall notify the Owner, in writing, of any equipment not in working order prior to the start of the Work. Start of Work will be considered as acknowledgement that all equipment is in good working order. Contractor shall be required to restore equipment to its original, or better, condition upon completion of the Project."

SG-3 Section H.2.1 is replaced with the following:

"Contractor shall provide, by or before the pre-construction conference, a detailed Construction Schedule for review and acceptance by the Owner. The submitted Construction Schedule must illustrate Work by significant project components, significant labor trades, long lead items, broken down by building and/or floor where applicable. Each Construction Schedule item shall account for no greater than 5% of the monetary value of the Project or 5% of the available time. Schedules with activities of less than one day or valued at less than 1% of the Contract shall be considered too detailed and shall not be accepted. Schedules lacking adequate detail, or unreasonably detailed, shall be rejected. Included within the Construction Schedule are the following: Notice to Proceed, Substantial Completion, and Final Completion. Contractor shall provide an updated, full project schedule with each payment request. In addition, twice monthly, the Contractor shall provide an updated three-week forward-looking Construction Schedule. Acceptance of the Schedule by the Owner does not constitute agreement by the Owner as to the Contractor's sequencing, means, methods, or durations. Any positive difference between the Contractor's scheduled completion and the contract completion date is float owned by the Project. Use of the float shall be negotiated. In no case shall the Contractor make a claim for delays if the Work is completed within the Contract time but after Contractor's scheduled completion."

As indicated in the General Conditions of your contract(s) Section E.2.9, OSU requires that we gather MWESB (Minority, Women's Emerging Small Business) Contractor/Subcontractor information. This is an Oregon State University requirement and the information will be gathered annually and at time of final payment.

- **You must do this step first or the report will not let you add any information: In Row 1 Column B there is a drop down menu. You must select yearend (if the job has not been completed) or final (if the job is completed and you have submitted for retention). Once you choose yearend or final in the drop down menu there will be areas highlighted in light green and red. Those are the areas that you are required to fill out. If you did not use or planning to use any MWESB then the left side of the report (Light Green area) still needs to be filled out and the red area needs to remain blank.**

- **If your agency is an MWESB or if you are using/used an MWESB subcontractor then you need to fill out the information in the report that is highlighted in light green and red (see instructions in the next bullet). If you are not an MWESB or used a Subcontractor that is an MWESB then you need to fill out the left side of the form (Light Green areas) and leave the red area blank.**

- **In row 2 Column B there is another drop down menu, click the drop down menu and choose Fiscal Year 2015.**

- **In Row 4 Column B there is another drop down menu, click there and choose OSU.**

Oregon University System

CapCon MWESB Subcontractor Report

REPORT BEING SUBMITTED	

OVERALL PROJECT DATA

Reporting Period	2011
Campus	
General Contractor's Name	
Contract Number	
Project Name	
Contract Execution Date (Date Contract was Signed by the Owner)	
Date of Final Payment Application	
Initial Total Contract Value	
Total Contract Value billed within the fiscal year (July 1 - June 30)	
Final Total Contract Value	
Total Number of Subcontractors/Suppliers Used on Project	
Total Number of First-Tier Subcontractors/Suppliers Used on Project	
Number of First-Tier MWESB Subcontractors/Suppliers	

CALCULATED REPORTING DATA (Self Calculating - No Data Entry)

Number of MWESB Subcontractors/Suppliers	0
% MWESB Subcontractors/Suppliers	
% First-Tier MWESB Subcontractors/Suppliers	

CERTIFIED MWESB TOTALS

Value Awarded to MWESB Contractors/Suppliers	$0.00
% Value Awarded to MWESB Contractors/Suppliers	
Value - **minority-owned** MWESB subcontractors/suppliers	$0.00
% - **minority-owned** MWESB subcontractors/suppliers	
Value - **women-owned** MWESB subcontractors/suppliers	$0.00
% - **women-owned** MWESB subcontractors/suppliers	
Value - **emerging small business** MWESB subcontractors/suppliers	$0.00
% - **emerging small business** MWESB subcontractors/suppliers	

SELF-IDENTIFIED or OTHER CERTIFIED MWESB TOTALS

Value - **self-identified or other certified** subcontractors/suppliers	$0.00
% - **self-identified or other certified** subcontractors/suppliers	

OVERALL PROJECT CONTRACT HISTORY

% Value Awarded to MWESB Contractors/suppliers at Initial Contract	#DIV/0!
% Value Awarded to MWESB Contractors/suppliers at Final Contract	#DIV/0!

FOR OFFICIAL USE ONLY:

Date Received by the Campus	
Initials of Campus staff who checked the document	

Individual Contractor/Sub-Contractor/Supplier Data Entry Matrix

Name of MWESB General/ Subcontractor/ Supplier	State of Oregon MWESB Certification Number	Self-Identified or Other Certified	Initial Sub-Contract Value	Sub-Contract value billed within the fiscal year (July 1-June 30)	Final Sub-Contract Value	Minority-Owned	Women-Owned	Emerging Small Business

In compliance with Oregon Prevailing Wage Law, the following is incorporated into this Invitation to Bid:

The Contractor and all subcontractors shall comply with the provisions of ORS 279C.800 through 279C.870, relative to Prevailing Wage Rates as outlined in Sections C.1 and C.2 of the General Conditions. This Purchase Order is subject to the following BOLI wage rate requirements, which are incorporated herein by reference:

- April1, 2019 PWR Apprenticeship Rates
- April1, 2019 PWR Amendments
- January 1, 2019 Prevailing Wage Rates for Public Works Contracts in Oregon
- July 1, 2018 Definitions of Covered Occupations for Public Works Contracts in Oregon

These BOLI wage rates are available on line at:
http://www.boli.state.or.us/BOLI/WHD/PWR/pwr_state.shtml

PROJECT MANUAL

OSU – Sports Performance Center – Weight Room Refresh

Oregon State University
Corvallis, Oregon

Prepared by
Gensler
500 S. Figueroa Street
Los Angeles, California 90071
213.327.3600
Fax 213.327.3601

Issue for Permit
June 12, 2019
Project Number 005.2096.200

DOCUMENT 00 01 70 - ARCHITECTURAL SEAL PAGE

ARCHITECT
Gensler
500 S. Figueroa Street
Los Angeles, California 90071
213.327.3600

June 12, 2019

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DIVISION 7 – THERMAL AND MOISTURE PROTECTION

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SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. The Work Contract consists of interior renovation of existing Sports Performance Center – Weight Room Refresh on the Oregon State University Campus, Corvallis, Oregon, including demolition of existing storage and offices. New construction shall include offices, meeting room entry portal, storage, fuel bar (by others), bi-fold doors and exterior ramp. Fuel bar area is for use only by students and staff and will not serve the public. New paint, flooring and electrical fixtures. Updated restroom finishes, no changes in fixture type or count.

B. Work shall be started within ten (10) calendar days after signing of Contract on behalf of Oregon State University. The Contract may not be signed prior to approval of the Contractor's Certificate of Insurance by Construction Contract Administration (CCA), Oregon State University. Work shall be completed within __60____ calendar days of date of executed Contract.

1.02 CONTRACTORS USE OF PREMISES

A. Contractor shall limit use of the Premises for work and storage to allow for:
   1. Owner occupancy, day and night.
   2. Public use, day and night.
   3. Security.
   4. Safe entry and exit for vehicles and pedestrians.
   5. Fire egress.

B. Coordinate all operations with the Owner's Authorized Representative during the construction period. A 96 hour notification is required prior to scheduled utility shutdowns or street closures, but more lead time is often required to schedule around other critical activities.

C. Limit Contractor's employee parking to locations designated at the Pre-construction Conference.

1.03 OWNER OCCUPANCY

A. The Owner will occupy the Premises during the entire period of construction for the conduct of normal operations. Cooperate with Owner's Authorized Representative in construction operations to minimize conflict and to facilitate the Owner's usage especially in the following areas:
   1. Restricted access and parking.
   2. Use of stairs.
   3. Storage space availability.

B. Conduct operations in such a way to ensure the least inconvenience to the general public, including:
   1. Limitations and easements.
   2. Emergency vehicle access.
   3. Building access to the public, day and night.

1.04 ASBESTOS AND OTHER HAZARDOUS MATERIAL

A. The Owner has made a reasonable attempt to locate and identify asbestos or other hazardous

material that may be encountered during the course of the Work.

B. If the Contractor observes or suspects the existence of asbestos, polychlorinated biphenyl (PCB) or other hazardous materials in the structure or components of the building, the Contractor shall immediately stop work and notify the Owner's Authorized Representative.

C. The Owner will arrange for the removal of asbestos, polychlorinated biphenyl (PCB) or other hazardous materials as required by Facilities Services personnel or by separate contract.

D. Schedule ten (10) days of slack or "down" time for the removal of hazardous materials without penalty to Owner for the delay of the Contract.

1.05 LEAD BASED PAINT

A. The Owner may have tested existing paint in the project area and if levels are found the following conditions apply.

B. Contractor shall remove paint as specified for surface preparation and capture removed material for disposal.

C. Contractor shall follow OSHA guidelines involving exposure to workers.

D. Owner will provide containers for Contractor's use at project site.

E. Contractor shall comply with the requirements of DEQ and EPA and shall submit a lead abatement plan.

F. Contractor shall separate lead contaminated material from effluent and water.

G. Owner will dispose of lead paint and effluent resulting from stripping operation.

H. Soil contaminated by stripping operations shall be replaced with topsoil.

END OF SECTION 01 11 00

SECTION 01 23 00

ALTERNATES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. The alternates described in this Section may be exercised at the option of the Owner within 60 days of the execution of the Contract.

B. It is generally the practice of the Owner to exercise alternates in numerical order.

C. The Owner reserves the right to accept the alternates without regard to order or sequence; but, such acceptance shall not impair the selection of a low, responsible and responsive bidder to whom the Contract may be awarded under an equitable bid procedure.

1.02 QUALITY ASSURANCE

A. For each alternate which is accepted, coordinate the work of the various trades involved, and modify surrounding work as required to complete the project as intended.

B. In the change-in-price figure for each alternate, include incidental costs which are attributable to adjustments in the work of other trades which may be required to achieve the contemplated and final conditions.

C. Questions:
   1. If there is a question regarding the extent, scope, nature, or intent of the alternates, contact the Owner's Authorized Representative for clarification.
   2. Failure on the part of the Contractor to clarify any unclear items shall not relieve the Contractor of the responsibility for performing the selected alternates in accordance with the intent and requirements of the Project Manual and Drawings.
   3. The description of the alternates hereinafter is qualitative and not quantitative; the Contractor shall determine the quantities of labor and materials and the extent of same required to execute the selected alternates in accordance with the intent and requirements of the Project Manual and Drawings.
   4. The applicable Sections of the Specifications apply to the work under each alternate.

1.03 LIST OF ALTERNATES

A. Alternate 1: Provide a price to furnish and install 1 card reader at existing Vestibule Door #V104D and 4 interior security cameras.

END OF SECTION 01 23 00

SECTION 01 24 76

APPLICATIONS FOR PAYMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Work of this Section includes forms and procedures for progress payments.

B. Related work specified elsewhere.
   1. For the primary discussion of payments, refer to OSU General Conditions, Section E, as supplemented.
   2. In compliance with OSU General Conditions, Section K, no payments beyond 75% will be made by the Owner before two complete copies of the draft Operation and Maintenance Manuals have been received for review by the Owner.

1.02 APPLICATION FORMS

A. For applications for payment, use sample contract payment request on company letterhead, or AIA Document G702, supported by AIA Document G703, Continuation Sheet, or similar document.

B. Prepare the Schedule of Values in such a manner that each major item of Work and each subcontracted item of Work is shown as a line item broken down in terms of material and labor costs on AIA Document G703, Application Certification of Payment, Continuation Sheet or similar format. The sample continuation sheet shall be the minimum Schedule of Values breakdown.

C. The Schedule of Values shall be submitted for review by the Owner prior to the first application for payment; and may be used when, and only when, accepted in writing by the Owner.

D. Payment request is to include the Contractor's Federal Tax Identification number and return address.

1.03 PAYMENTS

A. The Owner will make progress payments on account of the Contract once monthly for the scheduled duration of the project (i.e. three (3) payments on a three-month project), based on the value of work accomplished or materials on the job site, as stated in the Schedule of Values on the Application and Certificate Payment.

B. Notwithstanding the foregoing, as this project is scheduled to take ___2_____ months to complete, Owner will only make ___2___ payments, plus a final retainage payment, as applicable.

C. Complete and forward Application to the Owner on or about the 15th day of each month for work performed the previous month and include certified payroll statements as specified in the OSU General Conditions.

D. Submit one (1) copy of forms requesting payment to the Owner.

E. Payments will be made on protected materials on hand at the job site properly stored, protected, and insured.

F. Estimated quantities shall be subject to the Owner's review and judgment.

1.04 EARLY PURCHASE AND PAYMENT OF MATERIALS AND EQUIPMENT

A. Order materials and equipment requiring a long lead or waiting time early so as not to delay progress of the Work.

B. The Contractor will be reimbursed for early order materials or equipment upon receipt and verification of quality and quantity against submittals and shipping documents by the Owner's Authorized Representative.

C. Receipt shall be to the job site or stored at Owner's other premises in an orderly and safe manner, secured from normal weather damage.

D. Security remains the responsibility of the Contractor.

END OF SECTION 01 24 76

CONTRACT PAYMENT REQUEST

DATE: _____

TO: Administrative Services Accounting
Oregon State University
3015 SW Western Blvd
Corvallis, OR 97333

Payment Request No. _____Contract No. _____ Period from _____ to _____

Project: _____

Original Contract Amount ..... $_____

Change Orders (Net Amount) ..... $_____

Contract Total to Date ..... $_____

==========

Total Completed and Stored to Date ..... $_____

Less Retainage (5%), if applicable ..... $_____

Total Earned, Less Retainage (if applicable) ..... $_____

Less Previous Payments ..... $_____

Net Amount Due this Request ..... $_____

The undersigned Contractor certifies that, to the best of his/her knowledge, information, and belief, the Work covered by this request has been completed in accordance with the Contract Documents, that all amounts have been paid for Work for which previous applications for Payment were issued and payments received from the Owner, and that the amount shown herein is now due.

Contractor:_____

By: _____Date: _____

Federal Tax ID Number:_____

Address:_____

_____

CONTINUATION SHEET

Project Name:

Application No.:

Date:

Period To:

WRN No.:

NOTES:
Amounts are stated to the nearest penny.
Use Column I on Contracts where variable retainage for line items may apply, or if retainage is required.
Change Orders are usually listed as the last items of the basic schedule.

A	B	C	D	E	F	G		H	I
Item No.	**Description of work**	**Scheduled Value**	**Work Completed**		**Materials Presently Stored (Not in D or E)**	**TOTAL Completed & Stored (D+E+F)**	**% Completed (G/C)**	**Balance to Finish (C-G)**	**Retainage**
			From Previous Applications	This Period					
TOTALS									

SECTION 01 25 00

PRODUCT SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General requirements for the Work in relation to substitutions and product options.

B. Submit to the Owner's property insurance carrier shop drawings, samples, and product data (such as manufacturer's standard schematic drawings and other literature) when required by individual Specifications sections.

C. Related Work Specified Elsewhere
   1. Instructions to Bidders.
   2. OSU General Conditions.

1.02 REQUESTS FOR SUBSTITUTIONS

A. Requests for substitution of products in place of those specified shall be in accordance with Instructions to Bidders, and as specified herein.

1.03 CONTRACTOR'S RESPONSIBILITIES

A. Investigate proposed products and determine that they are equal or superior in all respects to products specified.

B. Provide same guarantee for accepted substitutions as for products specified.

C. Coordinate installation of accepted substitutions into the Work, making such changes as may be required for the Work to be complete in all respects.

1.04 SUBSTITUTIONS DURING BIDDING

A. Submit two (2) copies of the following information with each request to the Owner:
   1. CSI substitution request form.
   2. Comparison of proposed substitution with product, material or system specified.
   3. Complete data, substantiating compliance of proposed substitution with the Contract Documents.
   4. Test numbers and supporting reports, indicating compliance with referenced standards.
   5. Evidence that warranty requirements are acceptable.
   6. Details indicating specific deviations proposed for the substitution.
   7. Reference and applicable Specification sections.
   8. Applicable product samples.

B. All substitution requests shall be received in the Owner's office no less than ten (10) calendar days before bid opening. Requests received after this date will not be considered.

1.05 SUBSTITUTIONS DURING CONSTRUCTION

A. Substitutions will normally not be considered after date of Contract except when required due to unforeseen circumstances.

B. Within a period of thirty (30) days after date of Contract, the Owner may, at its option, consider formal written requests for substitution of products in place of those specified, when submitted in accordance with the requirements stipulated herein.

C. One or more of the following conditions must be documented in any such request:
   1. Required for compliance with final interpretation of code or insurance requirements.
   2. Required due to unavailability of a specified product.
   3. Required because of the inability of the specified product to perform properly or to fit in the designated space.
   4. Substitution would be substantially in the best interest of the Owner in terms of cost, time, or other considerations.

1.06 SUBSTITUTIONS NOT PERMITTED

A. If implied on submittals without first requesting approval thereof.

B. If acceptance will require substantial revision of the Contract Documents.

END OF SECTION 01 25 00

SUBSTITUTION REQUEST FORM

TO: _____

PROJECT: _____

SPECIFIED ITEM:

_____	_____	_____	_____
Section	Page	Paragraph	Description

The undersigned requests consideration of the following:

PROPOSED SUBSTITUTION: _____

Attached data includes product description, specifications, drawings, photographs, performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes description of changes to Contract Documents which proposed substitution will require for its proper installation.

The undersigned states that the following paragraphs, unless modified on attachments, are correct:

1. The proposed substitution does not affect dimensions shown on Drawings.

2. The undersigned will pay for changes to the building design, including engineering design, detailing and construction costs caused by the requested substitution.

3. The proposed substitution will have no adverse effect on other trades, the construction schedule, or specified warranty requirements.

4. Maintenance and service parts will be locally available for the proposed substitution.

The undersigned further states that the function, appearance and quality of the Proposed Substitution are equivalent or superior to the Specified Item.

Submitted by:

Signature _____

Firm _____

Address _____

_____

Date _____

Telephone _____

Attachments:

For use by Design Consultant:

☐ Accepted ☐ Accepted as noted

☐Not Accepted ☐ Received too late

By _____

Date _____

Remarks _____

SECTION 01 31 19

PROJECT MEETINGS

PART 1 GENERAL

1.01 PRE-CONSTRUCTION MEETING

A. Architect/Engineer/Designer, Contractor and Owner will meet prior to start of the Work (within seven (7) days after notice to proceed) to discuss at least the following topics and any others of mutual interest.
   1. Schedule of Values
   2. Permit Status/tree protection/erosion control
   3. List of sub-contractors
   4. Job inspections.
   5. Early purchase of, and/or lead time requirements for material and equipment/prepurchase of equipment
   6. Monthly payment date/SOP for pay requests
   7. Portion of site to be occupied by construction.
   8. Parking/Staging areas
   9. Non-smoking campus requirements
   10. Maintenance of access and safety.
   11. Processing of field decisions and change orders
   12. Labor provisions/labor rates for subs
   13. Material submittals/deferred submittals
   14. Owner access during construction.
   15. Review of Contract Documents/review ADA requirements/cross-slopes
   16. Coordination procedures and separate contracts.
   17. Progress schedules.
   18. Critical Work sequencing.
   19. Safety and emergency procedures/24 hour contact numbers
   20. Security procedures.
   21. Hazardous materials.
   22. Progress meetings.
   23. Contract close-out.

B. Location of Meeting: Project site

1.02 PROGRESS MEETINGS

A. The Contractor will schedule and administer progress meetings and will:
   1. Prepare agendas.
   2. Schedule progress meetings, frequency, time and day to be determined during pre-construction meeting.
   3. Make physical arrangements for and preside at meetings.
   4. Record minutes and include decisions.
   5. Distribute copies of minutes to participants within four (4) days after meetings.

B. Location of Meetings: Project site.

C. Attendance:
   1. The Owner or Owner’s Authorized Representative.
   2. Contractor.

3. Subcontractors affected by agenda.
4. Project Architect/Engineer/as necessary.
5. Owner will attend meeting to ascertain Work is expedited consistent with progress schedule and with Contract Documents.

D. Minimum Agenda:
1. Review and approve minutes from previous meeting.
2. Review Work progress since previous meeting.
3. Discuss field observations, and problems.
4. Review delivery schedules, construction schedule, and identify problems which impede planned progress.
5. Review proposed changes.
6. Material submittals.
7. Note all new subcontractors performing Work at the job site.

END OF SECTION 01 31 19

SECTION 01 33 23

SHOP DRAWINGS, PRODUCT DATA, SAMPLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submit to the Owner shop drawings, samples, and product data (such as manufacturer's standard schematic drawings and other literature) when required by individual Specifications sections.

B. Related Work Specified Elsewhere
   1. Instructions to Bidders.
   2. OSU General Conditions.

1.02 SUBMITTAL SCHEDULING

A. For items requiring review by the Owner only, submittals shall be sent to the Owner at least 15 calendar days before the date each is required for fabrication or installation.

B. Submittals to be reviewed by Owner's consultants shall be sent to the Owner at least 20 calendar days before the date each is required for fabrication or installation.

C. Submittals to be reviewed by Owner's property insurance carrier shall be sent to Owner as directed in individual specification sections.

D. Submittals involving Substitution requests or other modifications requiring review by the Owner and/or the Owner's consultants shall be sent to the Owner at least 20 calendar days before the date each is required for fabrication or installation.

1.03 SUBMITTAL CONTENT AND FORMAT

A. General Requirements:
   1. Shop Drawings: Submit in electronic format and, if requested by Owner's Authorized Representative, submit one reproducible transparency and 1 print of each drawing.
   2. Product Data: Submit electronically, and if requested by Owner's Authorized Representative, up to 6 hard copies.
   3. Samples: Submit the number and type stated in each Specification Section. Submit a minimum of three sets of color samples where color selection is required.
   4. Submittals shall include:
      a. Date and revision dates return date requested.
      b. Project title and number.
      c. The names of the Contractor, subcontractor, supplier, and manufacturer.
      d. Identification of product or material, with Specification Section number.
      e. Relation to adjacent critical features of work or materials.
      f. Field dimensions, clearly identified as such.
      g. Applicable standards, such as ASTM number or Federal Specification.
      h. Identification of deviations from Contract Documents, and for products accompanied by Substitution request as required by Section 01 25 00.
      i. Contractor's stamp legibly signed, essentially as follows:
         1) The undersigned, acting on behalf of the Contractor, certifies that this submittal has been reviewed and is approved; products have been verified as being as specified, field measurements and field construction criteria have been or will be coordinated, and the submittal is in compliance with Contract Documents.

5. Re-submission Requirements:
   a. Revise initial drawings as required and resubmit as specified for initial submittal.
   b. Indicate on drawings any changes which have been made other than those requested by the Owner or the owner's consultants.
6. The Owner may return without review any submittal not meeting the requirements listed above.

B. Shop Drawings:
1. Present data in a clear and thorough manner.
2. Details shall be identified by reference to sheet and detail, schedule or room numbers shown on Contract Documents.
3. Structural items shall be identified by location in the completed structure. Identify details by reference to contract sheet and detail numbers.
4. Minimum sheet Size: 8 ½ x 11".

C. Product Data:
1. Manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts, illustrations and other standard descriptive data:
   a. Clearly mark each copy to identify pertinent product or models.
   b. Show dimensions, weights, and clearances required.
   c. Show performance data consisting of capabilities, ROM, KW, pressure drops, design characteristics and consumption; conforming as closely as possible to the test methods referenced in the Plans and Specifications.
   d. Show wiring or piping diagrams and controls.
2. Manufacturer's standard schematic drawings and diagrams:
   a. Modify to delete information which is not applicable.
   b. Supplement standard information to provide information specifically applicable to the Work.

D. Samples:
1. Insure that samples are of sufficient size to indicate the general visual effect or color.
2. Where samples must show a range of color, texture, finish, graining, or other property, submit sets of pairs illustrating the full scope of this range.
3. One (1) sample or one (1) set of approved samples will be retained by the Owner; final work will be measured against approved samples.

1.04 QUALITY ASSURANCE

A. Process submittals in ample time for review, as applicable, so as to not delay the Work. All submittals shall be received by the Owner within ten (10) days after pre-construction.

1.05 DEFINITIONS

A. The Owner will mark reviewed materials as follows:
1. "No Exception Taken," which means fabrication, manufacture and/or installation may proceed.
2. "Make Revisions Noted," which means fabrication, manufacture and/or installation may proceed with revisions as noted.
3. "Revise and Resubmit," which means that fabrication, manufacture and/or installation may not proceed.
4. "Rejected," which means do not proceed; make arrangements for the review of the proposed Work with the Owner as soon as possible.

1.06 PROCESSING

A. Review submittals, make necessary corrections, and become familiar with the content of the submittals.

B. Mark each item with Contractor's stamp.

C. Accompany submittals with a transmittal letter bearing the project name, Contractor's name, number of items, and other pertinent data.

D. Keep one copy of each reviewed submittal on the job site at all times.

E. Be responsible for obtaining and distributing prints of shop drawings to the various suppliers, and the Owner once review process has been completed. Make prints of reviewed shop drawings only from transparencies which carry the appropriate stamp and endorsement.

END OF SECTION 01 33 23

SECTION 01 42 13

ABBREVIATIONS AND SYMBOLS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Words which may be found elsewhere in the Project Manual and Drawings are abbreviated in accordance with the standards set forth in the following table:

A/C	air conditioning
AB	anchor bolt
AC	asphaltic concrete
ACT	acoustical tile
AD	area drain
ADD	addendum
ADD'L	additional
ADH	adhesive
AFF	above finish floor
AGG	aggregate
AL	aluminum
ALLOW	allowable
ALT	alternate
ANOD	anodized
AP	access panel
APPRX	approximate
ARCH	architect(ural)
ASPH	asphalt
AUTO	automatic
AVE	avenue
BD	board
BIT	bituminous
BLDG	building
BLKG	blocking
BM	bench mark, beam(s)
BOT	bottom
BRZ	bronze
BS	both side
CB	catch basin
CEM	cement
CF	cubic foot
CFOI	contractor furnished owner installed
CG	corner guard
CH	ceiling height
CI	cast iron
CJ	control joint
CKBD	chalkboard
CL	centerline
CLG	ceiling
CLR	clear(ance)
CM	construction manager
CMT	ceramic mosaic (tile)
CMU	concrete masonry unit
COL	column
COM	communications
CONC	concrete
CONN	connect(ion)
CONST	construction
CONT	continuous or continue
CONTR	contract(or)
CPT	carpet
CRS	course(s)
CS	countersink
CSMT	casement
CT	ceramic tile
CTR	center
CVG	clear vertical grain
CW	cold water
CWT	ceramic wall tile
CY	cubic yard
D	depth
DEMO	demolish, demolition
DEP	depressed
DF	drinking fountain
DIA	diameter
DIAG	diagonal
DIM	dimension
DISP	dispenser
DIV	division

DL	dead load
DMT	demountable
DN	down
DP	dampproofing
DR	door
DS	downspout
DT	drain tile
DTL	detail
DW	dumbwaiter
DWG	drawing(s)
DWR	drawer
EA	each
EB	expansion bolt
EF	each face
EJ	expansion joint
EL	elevation
ELEC	electric(al)
EMBED	embedment
EMER	emergency
ENCL	enclose(ure)
EP	electrical panel board
EQ	equal
EQUIP	equipment
EST	estimate
EVT	equiviscious temperature
EW	each way
EWC	electric water cooler
EX.EXIT	existing
EXH	exhaust
EXP	exposed
EXT	exterior
FA	fire alarm
FAF	fluid applied flooring
FARF	fluid applied resilient floor
FAS	fasten, fastener
FBD	fiberboard
FBT	finished blowing temperature
FD	floor drain, fire damper
FE	fire extinguisher
FEC	fire extinguisher cabinet
FF	factory finish
FGL	fiberglass
FHMS	flathead machine screw
FHWS	flathead wood screw
FIN	finish(ed)
FLCO	floor cleanout
FLR	floor(ing)
FLUR	fluorescent
FND	foundation
FOC	face of concrete
FOIC	furnished by owner/installed by contractor
FOIO	furnished by owner/installed by owner
FOM	face of masonry
FP	fireproofing, flash point
FPHB	freeze-proof hose bib
FR	fire resistive, fire rated
FRM	frame(d), (ing)
FS	full size
FSS	finished structural slab
FT	foot
FTG	footing
FTS	finished topping slab
GA	gage, gauge
GALV	galvanized
GB	grab bar or gypsum board
GC	general contractor
GI	galvanized iron
GL	glass, glazing
GLS	glass resin wall surfacing
GP	gypsum
HB	hose bib
HBD	hardboard
HC	hollow core
HD	heavy duty
HDR	header
HDW	hardware
HM	hollow metal
HOR	horizontal
HP	high point
HR	hour
HT	height
HTG	heating
HVAC	heating, ventilating, air conditioning
HWD	hardwood
HWH	hot water heater
ID	inside diameter, identification
IN	inch
INCIN	incinerator
INCL	include(d), ion)

INT	interior
INV	invert
JB	junction box
JC	janitor's closet
JT	joint
KD	kiln dried
KCP	Keene's cement plaster
KO	knockout
KP	kick plate
LAB	laboratory
LAM	laminate(d)
LAV	lavatory
LBS	pounds
LH	left hand
LL	live load
LONGIT	longitudinal
LP	low point
LW	lightweight
MAX	maximum
MB	machine bolt
M. MECH	mechanic(al)
MFR	manufacture(r)
MH	manhole
Min	minimum, minute
MISC	miscellaneous
MO	masonry opening
MO#	model number
MOD	modular
MPH	miles per hour
MS	machine screw
MTL	metal
MULL	mullion
MWP	membrane waterproofing
NAT	natural, natural finish
NIC	not in contract
NO	number
NOM	nominal
NTS	not to scale
OA	overall
OBS	obscure
OC	on center(s)
OD	outside diameter
OF	overflow
OFCI	owner furnished contractor installed
OFOI	owner furnished owner installed
OHMS	ovalhead machine screw
OHWS	ovalhead wood screw
OPG	opening
OPP	opposite
OZ	ounce(s)
P	paint(ed)
PB	push button
PCF	pounds per cubic foot
PCP	putting coat plaster
PERF	perforate(d)
PL	plate, property line
PLAM	plastic laminate
PLAS	plaster
PNL	panel
PP	push plate
PR	pair
PREP	prepare
PSF	pounds per square foot
PSI	pounds per square inch
PT	point, pressure treated
PTN	partition
PVC	polyvinyl chloride
PWD	plywood
QT	quarry tile
R	rise
RA	return air
RAD	radius
RCP	reflected ceiling plan
RD	roof drain
REF	reference
REFR	refrigerator
REINF	reinforce(ing)
REQ	required
RET'G	retaining
REV	revision(s), revised
RH	right had
RM	room
RO	rough opening
RSF	resilient sheet flooring

SC	solid core
SCHED	schedule
SEC	section
SF	square feet (foot)
SHT	sheet
SHTHG	sheathing
SIM	similar
SL	sleeve
SOG	slab on grade
SPEC	specification(s)
SQ	square
SS	storm sewer
S4S	finished 4 sides
SD	storm drain
ST	steel, street
ST ST	stainless steel
STD	standard
STR	structural
SUPP	supplement
SUPT	support
SUSP	suspended
SV	sheet vinyl
T	tread
TBM	top bench mark
T&G	tongue and groove
TB	towel bar
TC	top of curb
TEL	telephone
TEMP	tempered
THK	thickness
TKBD	tackboard
TO	top of
TP	top of paving
TRANS	transverse
TS	top of slab
TV	television
TW	top of wall
TYP	typical
UNO	unless noted otherwise
VAT	vinyl asbestos tile
VB	vapor barrier
VCT	Vinyl Composition Tile
VERT	vertical
VG	vertical grain
VIF	verify in field
VWC	vinyl wall covering
W	width, wide, water
W/	with
W/O	without
WC	water closet
WD	wood, wood finish
WP	waterproof(ing)
WNS	wainscot
WR	water resistant
WS	waterstop
WW	window wall
WWC	wood wall covering
WWF	woven wire fabric

B. Words which may be found elsewhere in the Project Manual and Drawings are abbreviated in accordance with the standards set forth in the following table:

& and
λ angle
@ at
ι diameter, round
" inches
: is, shall b
' feet
ζ perpendicular
/ per
% percent
# pound, number
X by (as in 2 by 4)

END OF SECTION 01 42 13

SECTION 01 42 16

DEFINITIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Words which may be found elsewhere in the Contract Documents are defined in accordance with the standards set forth in the following table:

Approve:

Where used in conjunction with Architect's response to submittals, requests, applications, inquiries, reports and claims by Contractor, the meaning of term "approved" will be limited to the Architect's responsibilities and duties as specified in General and Supplementary Conditions. In no case will "approval" by Architect be interpreted as a release of Contract requirements.

As Detailed, As Shown:

Where “as detailed”, “as shown” or words of similar importance are used, it shall be understood that reference to the Drawings accompanying the Specifications is made unless otherwise stated.

As Directed, As Required, As Authorized, As Reviewed, As Accepted:

Where “as directed”, “as required”, “as authorized”, “as reviewed”, “as accepted” or words of similar importance are used, it shall be understood that the direction, requirement, permission, authorization, review, or acceptance of the Architect is intended, unless otherwise stated.

As Indicated:

Where “as indicated” is used it shall be understood that reference to Drawings and/or Specifications is made unless otherwise stated.

Directed, Requested, etc.:

Terms such as "directed," "requested," "authorized," "selected," will be understood as "directed by Architect," "requested by Architect," and similar phrases shall not be interpreted to extend Architect's responsibility into Contractor's responsibility for construction supervision.

Furnish:

Except as otherwise defined in greater detail the term "furnish" is used to mean supply and deliver to project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

Indicated:

The term "indicated" is a cross-reference to graphic representations, notes or schedules on drawings, to other paragraphs or schedules in the specifications and to similar means of recording requirements in Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated," it is for purpose of helping reader locate cross-reference and no limitation of location is intended except as specifically noted.

Install:

Except as otherwise defined in greater detail, the term "install" is used to describe operations at

project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations, as applicable in each instance.

Installer:

The term "installer" is defined as the entity (person or firm) engaged by Contractor, or its subcontractor or sub-subcontractor for performance of a particular unit of Work at project site, including installation, erection, application and similar required operations. It is a general requirement that such entities (Installers) be expert in operations they are engaged to perform.

Provide:

Except as otherwise defined in greater detail, term "provide" means furnish and install, complete and ready for intended use, as applicable in each instance.

END OF SECTION 01 42 16

SECTION 01 42 19

REFERENCE STANDARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Quality Assurance.

B. Location of References.

C. Schedule of References.

1.02 QUALITY ASSURANCE

A. For products or quality of work specified by association, trade, or federal standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date of Contract Documents.

C. General Applicability of Standards: Except where Contract Documents include more stringent requirements, applicable standards of the construction industry have the same force and effect as if bound or copied directly into Contract Documents.

D. Such standards are made a part of the Contract Documents by reference.

E. Individual sections indicate which codes and standards the Contractor must keep at the project site, available for reference.

F. Referenced industry standards take precedence over standards which are not referenced but recognized in industry as applicable.

G. Non-referenced standards are not directly applicable to the Work, except as a general requirement of whether the Work complies with standards recognized in the construction industry.

1.03 LOCATION OF REFERENCES

A. Valley Library, Oregon State University.

1.04 SCHEDULE OF REFERENCED ASSOCIATIONS

AIA	American Institute of Architects WWW.AIA.ORG
AISC	American Institute of Steel Construction WWW.AISC.ORG
AISI	American Iron and Steel Institute

WWW.STEEL.ORG

ANSI	American National Standards Institute WWW.ANSI.ORG
APA	American Plywood Association WWW.APAWOOD.ORG
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers WWW.ASHRAE.ORG
ASTM	American Society for Testing and Materials WWW.ASTM.ORG
AWPA	American Wood Protection Association WWW.AWPA.COM
AWS	American Welding Society WWW.AWS.ORG
BIA	Masonry Institute of America WWW.MASONRYINSTITUTE.ORG
BOLI	Oregon Bureau of Labor and Industries WWW.BOLI.STATE.OR.US
CCB	Construction Contractors Board WWW.OREGON.GOV.CCB/
CDA	Copper Development Association WWW.COPPER.ORG
CISPI	Cast Iron Soil Pipe Institute WWW.CISPI.ORG
CSI	Construction Specification Institute WWW.CSINET.ORG
DEQ	Department of Environmental Quality (Oregon) WWW.OREGON.GOV/DEQ/
DHI	Door and Hardware Institute WWW.DHI.ORG
DOT	Department of Transportation WWW.DOT.GOV
EPA	U.S. Environmental Protection Agency WWW.EPA.GOV
FM	Factory Mutual System

WWW.FMGLOBAL.COM

FS	Federal Specification General Services Administration Specifications and Consumer Information Distribution Section (WFSIS) WWW.GSA.GOV/PORTAL/CONTENT/103856
IBC	International Building Code WWW.ICCSAFE.ORG
ICBO	International Conference of Building Officials PUBLICECODES.CITATION.COM/ICOD/IBG/INDEX.HTM
IRS	Internal Revenue Service WWW.IRS.GOV
ISA	Instrumentation Systems and Automation Society WWW.ISA.ORG
NAAMM	National Association of Architectural Metal Manufacturers WWW.NAAMM.ORG
NBFU	National Board of Fire Underwriters WWW.NFPA.ORG
NEC	National Electric Code WWW.NECPLUS.ORG
NEMA	National Electrical Manufacturers' Association WWW.NEMA.ORG
NESC	National Electrical Safety Code WWW.IEEE.ORG
NFPA	National Fire Protection Association WWW.NFPA.ORG
NRCA	National Roofing Contractors' Association WWW.NRCA.NET
OAR	Oregon Administrative Rules ARCWEB.SOS.STATE.OR.US/404.HTML
OESP	State of Oregon Electrical Specialty Code http://www.bcd.oregon.gov/programs/online_codes.html
ORS	Oregon Revised Statutes LANDRU.LEG.STATE.OR.US/ORS/
OSHA	Occupational Safety and Health Administration WWW.OSHA.GOV
OSSC	Oregon Structural Specialty Code

http://www.bcd.oregon.gov/programs/online_codes.html

PS	Product Standard STANDARDS.GOV/STANDARDS.CFM
SDI	Steel Door Institute WWW.STEELDOOR.ORG
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association WWW.SMACNA.ORG
SPRI	Single Ply Roofing Institute WWW.SPRI.ORG
SSPC	Steel Structures Painting Council WWW.SSPC.ORG
SWRI	Sealing, Waterproofing and Restoration Institute WWW.SWIRONLINE.ORG
UBC	Uniform Building Code (See ICBO)
UFC	Uniform Fire Code WWW.NFPA.ORG
UL	Underwriters' Laboratories, Inc. WWW.UL.COM
UMC	Uniform Mechanical Code WWW.UBC.COM
UPC	Uniform Plumbing Code WWW.UBC.COM
WHL	Warnock Hersey Laboratories WWW.INTEK.COM/MARKS/WH/
WCLIB	West Coast Lumber Inspection Bureau WWW.WCLIB.ORG
WWPA	Western Wood Products Association WWW.WWPA.ORG

END OF SECTION 01 42 19

SECTION 01 45 00

QUALITY CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Codes, regulations and permits.

B. Procedures for quality control.

1.02 OWNER RESPONSIBILITIES

A. Owner will employ and pay for services of an independent testing laboratory to perform inspection, sampling and testing as required by local building authority.

B. Owner's Authorized Representative will provide on-site observation during construction.

1.03 CODES, REGULATIONS AND PERMITS

A. All Work shall conform with the Oregon Structural Specialty Code (OSSC) based on the International Building Code (IBC), as amended by the State of Oregon Building Codes Division and the edition designated by the governing authority.

B. Contractor shall comply with all applicable state and local construction codes.

C. References to codes, Specifications and standards referred to in the Contract Documents shall mean, and are intended to be, the latest edition, amendment or revision of such reference standard in effect as of the date of these Contract Documents.

D. The Owner shall be responsible for all permits and City of Corvallis plan review fees; the Contractor shall be responsible for all licenses and associated fees required for the Project.

E. Contractor shall arrange and attend all required permit inspections and furnish evidence of approved City inspection reports per Section 01 77 00.

1.04 QUALITY OF WORK

A. It is the true and specific intent of these Specifications that quality of Work on all phases of the construction and embracing all the trade sections shall be of high quality performed by workers skilled in their trade and performing their Work only according to the standard of best practice of the trade.

B. All manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with manufacturer's directions unless otherwise specified.

C. If Work is required in a manner to make it impossible to produce first quality Work, or should discrepancies appear among Contract Documents, request interpretation from Architect before proceeding with Work.

D. Failure to secure interpretation may cause rejection by Architect or owner of installation.

1.05 LAYOUT

A. Be responsible for properly laying out the Work and for lines and measurements for the Work.

B. Verify the figures shown on the drawings before laying out the Work and report errors or inaccuracies to the Architect before commencing Work.

C. Strict compliance with maximum slopes is required. Accessible parking spaces and adjacent access aisles with slope exceeding 2% in any direction, as determined by OSU, shall be removed and replaced by the contractor at their expense.

D. Strict compliance with maximum slopes is required. New sidewalks exceeding 1:20 slope or with cross slope exceeding 2%, as determined by OSU, shall be removed and replaced by the contractor at their expense. Ramps exceeding 1:16 slope or with cross slope exceeding 2%, as determined by OSU, shall be removed and replaced by the contractor at their expense.

1.06 SUPERVISION

A. The Contractor shall maintain effective supervision on the project at all times Work is being performed.

B. The superintendent shall be the same person throughout the project and shall attend the preconstruction conference.

1.07 INSPECTIONS AND TESTING

A. Contractor shall notify the Owner at least twenty-four (24) hours in advance of any required progress inspection or final inspection including final punch list inspection.

B. Cooperate with laboratory personnel, provide access to Work and furnish incidental equipment material and labor required for field testing and sample taking.

1.08 EVALUATION OF TESTS AND INSPECTIONS

A. Results of laboratory and/or field control tests and inspections shall be the principal basis upon which satisfactory completion of Work shall be judged.

B. If results of tests and inspections indicate Work is below requirements of Contract Documents, that portion of Work is subject to rejection.

1.09 ADJUSTMENTS

A. Remove and replace Work so rejected at Contractor's expense including costs of subsequent tests and inspections until Work meets requirements of Contract Documents.

B. The Owner reserves the right to perform any testing as may be required to determine compliance with the Contract Documents.

C. Costs for such testing will be the Owner's responsibility unless testing indicates noncompliance. Cost for such testing indicating noncompliance shall be borne by the Contractor.

D. Noncomplying Work shall be corrected and testing will be repeated until the Work complies with the Contract Documents.

E. Contractor will pay costs for retesting noncomplying Work.

END OF SECTION 01 45 00

SECTION 01 51 00

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This Section specifies requirements for temporary services and facilities, including utilities, construction and support facilities, security and protection.

1.02 REQUIREMENTS OF REGULATORY AGENCIES

A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction.

B. Standards: Comply with NFPA Code 241, "Building Construction and Demolition Operations", ANSI-A10 Series standards for "Safety Requirements for Construction and Demolition".

C. Electrical Service: Comply with NEMA, NEC and UL standards and regulations for temporary electric service; install service in compliance with National Electric Code (NFPA 70).

D. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use; obtain required certifications and permits if required.

1.03 PROTECTION

A. Protect sidewalks, asphalt paving, concrete, trees, shrubs, and lawn areas at all times from damage resulting from construction activities.

B. Prevent materials from clogging catch basins and yard drains; leave drains clean and in proper working condition.

C. Protect Existing Irrigation Systems:
   1. In the event damage occurs to an underground irrigation system as a direct result of a Contractor's activities, the Contractor shall repair/replace or be assessed a charge at the discretion of the Owner.
   2. If repairs are to be made by the Contractor, the repairs will be inspected by the Owner’s Authorized Representative prior to backfilling.
   3. Any galvanized pipe that requires repair shall be repaired at a threaded coupling, not by use of a compression coupling.

D. Protect Existing Air Handling Systems:
   1. Contractor shall be responsible for protection of the cleanliness of the existing air handling system at all times. This protection shall include:
      a. During site work or building demolition, prefilters shall be provided and maintained on all building outside air intakes at all times throughout the construction duration.
      b. During any interior work that may create dust in the interior space and adjacent corridor/hallways, air filters shall be provided and maintained on all affected air return and exhaust grilles. Where air flow in or out of the space is not required, all air duct openings shall be temporarily blanked off with plywood or sheet metal.
      c. Prior to starting any work, the Contractor shall record and submit to the Owner’s Authorized Representative, pressure readings across all existing air handler air filter banks before installation of new prefilters.
      d. Upon completion of all Work affecting existing air handling systems, the Contractor shall remove all temporary filters, covers and associated parts and restore the system

to its original operating condition unless otherwise stated elsewhere in the Contract Documents

E. Clean, repair, resurface, or restore existing surfaces to their original, or better, condition, or completely replace such surfaces to match existing, where damaged by construction operations.

F. Security is the responsibility of the Contractor.

G. Construction Debris:
   1. Debris shall not be allowed to remain around the buildings during performance of Work, but shall be disposed of as rapidly as it accumulates.
   2. On completion of Work, the buildings and grounds shall be left in a condition that is equal to or better than original condition.
   3. In case of failure to do so, the Owner may remove rubbish and charge the cost to the Contractor.

H. The Contractor shall manage a safe job environment for both the safety of all the people around the Work site as well as the safety of the Owner's and general public's property.

I. The Contractor shall provide and maintain suitable barricades, shelters, lights, and danger signals during the progress of the Work; they shall meet the requirements of the local building code and OSHA.

1.04 DRAINAGE

A. Verify that all rain drains in the construction areas are in working order and notify the Owner’s Authorized Representative in writing of any rain drains that are plugged, prior to the start of the Work.

B. Start of Work will be considered as acknowledgment that all drains are clear and in good working order.

C. All drains shall be left in a clean and proper working condition.

1.05 CONSTRUCTION PROJECT SAFETY FORM

A. Contractor shall submit to the Owner, prior to signing the Contract, the completed "Construction Project Safety Form", which is provided with instructions at the end of this Section.

1.06 TEMPORARY UTILITIES

A. Temporary Utilities:
   1. Prepare a schedule indicating dates for implementation and termination of each temporary utility.
   2. At the earliest feasible time, when acceptable to the Owner, change over from use of temporary service to use of the permanent service.

B. Conditions of Use:
   1. Keep temporary services and facilities clean and neat in appearance.
   2. Operate in a safe and efficient manner.
   3. Take necessary fire prevention measures.
   4. Do not overload facilities or permit them to interfere with progress.
   5. Do not allow hazardous, dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.

C. Electrical Service:
   1. Service limited to 20 amp 120V circuits will be paid for by the Owner.
   2. Connection to the service shall be the responsibility of the Contractor, with the Owner's approval.
   3. Coordinate with the Owner's Authorized Representative.

D. Water Service:
   1. Service in reasonable quantities for the Project will be paid for by the Owner.
   2. Connection to the service shall be the responsibility of the Contractor, with the Owner's approval.
   3. Coordinate with the Owner's Authorized Representative.

1.07 TEMPORARY SUPPORT FACILITIES

A. Temporary Sanitary Facilities:
   1. Provide and maintain an adequate number of facilities for the use of all persons employed on the Work during construction.
   2. Provide enclosed, weatherproof facilities with heat as required.
   3. Use of new or existing Owner's facilities will not be permitted.

B. Temporary Heat and Ventilation:
   1. As necessary, provide temporary heat and ventilation required by construction activities, for curing or drying of completed installations or protection of installed construction from adverse effects of low temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition required and minimize consumption of energy.

C. Telephone Equipment: Provide telephone communications at project site.

D. Existing Services:
   1. Do not interrupt any existing service.
   2. Prior request and approval of the Owner's Representative will enable the Owner to shut down any utility required by the Work.
   3. Contractor shall not shut down utilities.

1.08 TEMPORARY BARRIERS AND ENCLOSURES

A. Provide barriers and fencing to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage.

B. Provide Commercial grade chain link fence construction.

C. Provide 6 foot high fence around construction site as directed by Owner’s Authorized Representative; equip with vehicular and pedestrian gates with lock.

D. Exterior Closures: Provide temporary secured, weather-tight closures at exterior openings, to permit acceptable working conditions and protection of the Work.

E. Interior Closures:
   1. Provide temporary floor to ceiling partitions (not plastic sheeting) and ceilings as required to separate work areas from Owner occupied areas, to prevent penetration of dust and moisture into Owner occupied areas, to reduce construction noise, and to prevent damage to existing materials and equipment.
   2. Paint surfaces exposed to view from Owner occupied areas.

1.09 ODORS

A. Work that causes excessive odors shall be performed only after coordination with the Owner's Authorized Representative. Filtering of air intakes to units may be required to prevent odors and vapors from entering the buildings.

B. Contractor shall provide 7 days advance notice to the Owner's Authorized Representative in order for advance notice to be forwarded to building occupants. Work stoppage may occur if advance notification has not been coordinated or odors and vapors from the work are found to generate complaints from building occupants.

1.10 FIRE SAFETY

A. Ensure that required exit routes remain unobstructed while building is occupied.

B. Abide by all fire safety requirements for buildings under construction, alteration or demolition as required by Article 87, of the Uniform Fire Code as adopted by the State of Oregon.

C. An emergency telephone shall be provided on site. Cellular telephone equipment is acceptable.

D. Fire Suppression Equipment:
   1. Install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10 "Standard for Portable Fire Extinguishers", and NFPA 241 "Standard for Safeguarding Construction, Alterations and Demolition Operations".
   2. Maintain equipment in working condition with current inspection certificate attached to each.
   3. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stairwell.
   4. Store combustible materials in containers in fire-safe locations.
   5. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways, and other access routes for fighting fires.
   6.
   6. Provide continual supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.
   7. When possible, relocate hot work to a designated hot work area.
   8. If the materials or equipment cannot be relocated to a designated hot work area, use the least hazardous form of hot work that will get the job done and prepare the area properly.
   9. Manage mobile hot work using the formal hot work permit system. (mentioned in the next bullet point and also a directive in the OSU Hot Work Safety Program)
   10. Make sure both fire protection and hot work equipment work properly.
   11. Train all personnel involved in hot work operations and activities so that they have the understanding, knowledge, and skills necessary to safely perform their jobs.

1.11 CONSTRUCTION AIDS

A. Scaffolding: comply with applicable OSHA requirements.

B. Material Handling Equipment:
   1. Provide necessary cranes, hoists, towers, or other lifting devices.
   2. Use only experienced operators.
   3. Remove equipment as soon as possible after task is ended.
   4. Coordinate placement of such equipment with Owner's Authorized Representative.
   5. Obtain required permits and meet requirement of governing authorities regarding applicable regulations.

C. Materials or debris shall not be allowed to free fall from building.

D. The use of chutes or conveyors must be approved by Owner.

1.12 TEMPORARY CONTROLS

A. Water Control:
   1. Maintain excavations free of water.
   2. Provide, operate, and maintain necessary pumping equipment.

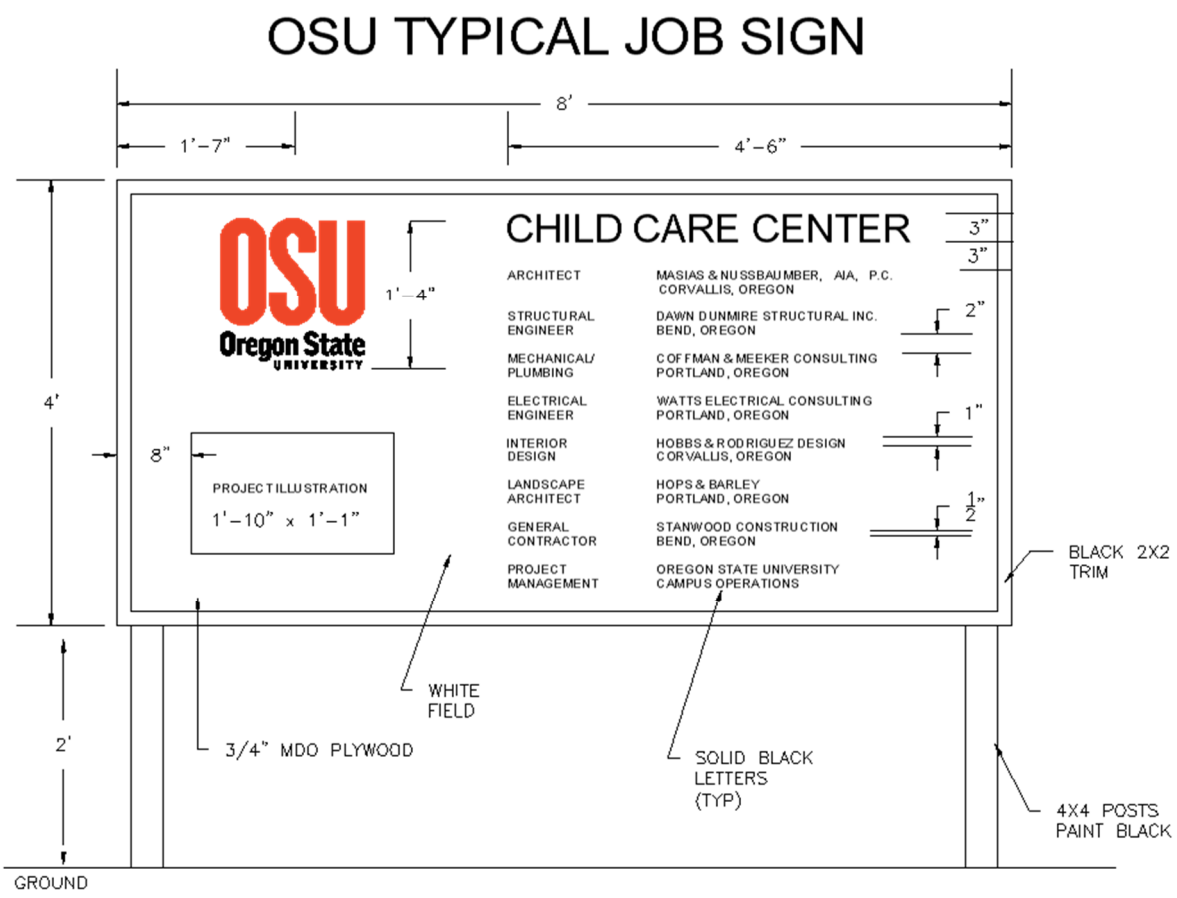
B. Protection:
   1. Protect installed Work and provide special protection where specified in individual specification sections.
   2. Prohibit traffic or storage upon waterproofed or roofed surfaces.

C. Security:
   1. Provide security and facilities to protect Work and existing facilities and Owner's operations from unauthorized entry, vandalism, or theft.
   2. Coordinate operations with Owner's Authorized Representative.

D. Temporary Traffic Control /Pedestrian Accessibility
   1. A continuous route for all pedestrians, including persons with disabilities and bicyclists, shall be maintained at all times. When existing pedestrian facilities are disrupted, closed, or relocated in a construction zone, temporary pedestrian facilities shall be provided.
   2. Temporary pedestrian facilities should be safe and accessible. There should be no curbs or abrupt changes in grade that could cause tripping or be a barrier to wheelchair use.
   3. Signage shall be provided directing people to the temporary accessible route. The signage shall include the International Symbol of Accessibility.
   4. Contractors shall not block temporary walkways with vehicles, equipment, construction materials, signs, trash, or other objects that might prohibit pedestrian passage.
   5. Construction equipment and equipment operation must be separated from any open walkways. At construction zones, pedestrian fences or other protective barriers shall be provided to prevent access into the construction zone.

1.13 PROJECT SIGNAGE

A. Contractor is permitted to post only one project identification sign based on the following example:



1.14 PREPARATION

A. Consult with Owner to review jobsite areas required for field offices, material storage and stockpiles, equipment storage, access to different locations, etc.

1.15 PERFORMANCE

A. Confine equipment, apparatus, and storage of material to work limits. The Owner will not be responsible for protection of materials and equipment from damage, pilfering, etc.

B. Install temporary facilities in such a manner that the installed work will not be damaged.

C. Do not use facilities of existing building unless authorized in writing by the Owner.

D. Effective September 1, 2012, OSU became a non-smoking campus and smoking is prohibited on all Campus property.

E. Keep facilities well maintained.

F. Relocate temporary facilities as required during job progress.

G. At Substantial Completion, clean and renovate permanent facilities that have been used during the construction period, including but not limited to:
   1. Replace air filters and clean inside of ductwork and housings.
   2. Replace significantly worn parts and parts that have been subject to unusual operating

conditions.

3. Replace lamps that are burned out or noticeably dimmed by substantial hours of use.

END OF SECTION 01 51 00

Oregon State University Construction and Maintenance Safety Requirements
EH&S, 130 Oak Creek Building, Corvallis, OR 97331-7405, (541) 737-2505,
FAX (541) 737-9090

Complete OSU Construction and Maintenance Safety Form - Send completed documents (including Site Safety Plan and all separate answer pages) to Construction Contract Administration along with the signed contract and bonds.

Project Isolation - All construction and remodeling activities regardless of size and/or scope must be fenced, barricaded, or otherwise protected to restrict entrance and to ensure the safety of those in the general area. See isolation requirements.

Site Safety Plan - A site safety plan will be required and will address:

- General Information
- Emergency Information
- Key Organization Personnel
- Hazard Evaluation/Facility Impact
- Emergency Procedures
- Work Zones
- Security Measures
- Fire Protection

A model plan is attached. This form can be used if another plan has not already been prepared. Contact OSU Environmental Health & Safety for more information 737-2505.

Isolation Requirements

General: All construction, maintenance, and remodeling activities, regardless of size or scope, must be fenced, barricaded, or otherwise isolated to restrict entrance and to ensure the safety of those in the general area.

Outdoor Activities: Outdoor projects require the following perimeter isolation:

- A six foot chain-link fence, with controlled access points, extending in all directions around the excavation or building site such that no area of the construction is accessible to pedestrians or unauthorized personnel or vehicles.
- Isolation area will include vehicle loading and unloading areas.
- At the University's option, other barricading plans may be accepted. These may apply to projects such as road resurfacing, parking lot striping, exterior building water proofing, deliveries, etc. Contact EH&S regarding other barricading plans.

Overnight: Any excavation across or adjacent to sidewalks or pathways which must be left open overnight, must be identified with working, blinking construction lights in addition to solid barricades

Indoor Activities: Indoor construction or maintenance projects which will create dust, potentially hazardous fumes or vapors, or offensive odors are subject to the following isolation:

- Areas where existing doors can provide isolation will be labeled "Construction Area--Authorized Personnel Only ".
- All other areas will be isolated by a solid barrier. The minimum barrier allowed is 4 mil poly sheeting sealed to prevent migration of dust.
- Mechanical ventilation may be required.
- A solid wall is required if building envelope is opened to the outside.

Contractor Responsibilities

- The contractor will provide all barricading, isolation, and fencing material. OSU will not provide any materials.

- The contractor will also provide all appropriate warning and detour signs when sidewalks, exits, or roads are closed.
- Contractor will provide all other construction area signs.

OSU Construction and Maintenance Safety Form

Send completed safety documents to Construction Contract Administration with contract and bonds.

Date: _____ Project: _____

Start Date: _____ Completion date: _____

Contractor: _____ Contact: _____

Work # _____ 24 hr #: _____

OSU Project Mgr: _____ Work / 24hr #'s: _____

Dept Contact: _____ OSU EH&S Contact: _____

Preconstruction meeting? **Y N** Date/Time/Location: _____

For the following items, prepare answers on a separate sheet for all items marked "Yes". Precede each answer with the appropriate item number. All boxes need to be checked

Y	N	For This Project	If YES, then:
		1 Will any confined spaces be accessed?	Describe location of entry Specify location of permit Notify EH&S prior to entry See SAF 209
		2 Will hot work be performed (welding, cutting, brazing, etc.)?	Provide min. 5# 2A10BC extinguisher within 10 ft If indoors - provide and describe ventilation See SAF 214
		3 Any products brought to campus?	Provide MSDS on site prior to first use; Make available to OSU on request
		4 Will lead paint be impacted?	Describe plan to limit contamination
		5 Will asbestos-containing-material be impacted?	Coordinate with OSU asbestos manager
		6 Will any materials (construction debris, soil, water, etc) be removed from campus?	Describe in detail identity and disposition of material (how, where)
		7 Any open trenches or holes?	Describe isolation procedures (see Page 1)
		8 Will a crane be used?	Describe crane safety plan (include plan to prevent loads above occupied areas)
		9 Is this project building a new facility, a major remodel?	Provide Site Safety plan Describe isolation procedures (see Page 1)
		10 Is this a minor remodeling project?	Provide, or fill out model Site Safety Plan form (see Page 3) Describe isolation procedures (see Page 1)
		11 Will air contamination be produced (e.g. dust, CO, solvent vapors, VOCs, odors)?	Describe project ventilation and isolation Indicate position of building air intake(s)
		12 Will there be noise > 85 dB?	Describe noise minimization plan
		13 Will this project use a scaffold or an external chute?	Describe isolation, dust control, installation
		14 Will this project involve a working surface >6' above a lower level	Describe fall protection
		15 Will any "blind" saw-cuts or penetrations be made in existing foundations, floors, ceilings and/or walls?	Describe plan for detecting and protecting power lines or other building utility lines.

EH&S Review: _____ Date: _____

Model Site Safety Plan

1. General Information

Contractor name_____
Address_____
City, State, Zip_____
Site Safety Officer_____ Project Dates_____
Project Name_____

2. Emergency Information

Emergency Response	911	OSU EH&S and OSU Facilities Services must be notified in the event of an emergency
Hazardous Materials Spill		
MSDS on-site location		
OSU EH&S	(541) 737-2505	
Facilities Services	(541) 737-2969	

3. Contractor Key Personnel

	Name	Phone	Emergency Contact
Company Owner			
Project Manager			
Job Supervisor			
Site Safety Officer			
Other Responsible Individual			
24 Hour Notification			

List of employees on site _____

4. Hazard Evaluation/ Facility Impact	
Physical	**Yes / No**
Heavy Equipment	
Noise	
Heat	
Elevation	
Radiation Materials	
Excavations	
Underground Utilities	
Confined Spaces	
Fire Prevention	
Electrical	

5. Emergencies
Services
Evacuation Route
First Aid Location
Hazardous Materials Spill Procedure

6. Work Zones

Material Storage_____
Parking locations_____
Individuals with OSU keys_____
Access issues_____

7. Security measures_____

8. Fire protection _____

SECTION 01 56 39

TREE AND PLANTING PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section includes temporary fencing, barricades, and guards to protect trees, plants and groundcovers not indicated to be removed, as necessary and required to prevent damage above and below grade.

1.02 DEFINITIONS

A. Dripline: Outer perimeter of branches of any tree or plant.

B. Groundcover: Includes but not limited to plants and grass.

1.03 PERFORMANCE REQUIREMENTS

A. The Contractor shall exercise utmost care to protect existing trees and plants designated to remain and shall comply with all protection requirements provided by Owner and City of Corvallis as conveyed through the Owner's Authorized Representative.

B. The Contractor shall install tree protection fencing as detailed and shall prevent damage to shrubs, groundcover, trees, root systems, soil, bark, foliage, branches and limbs due to construction activities, including but not limited to:
   1. Soil contamination, erosion, and compaction.
   2. Excessive wetting, and ponding due to storm water, and construction run-off.
   3. Alteration of grade, stockpiling of soil, debris, and materials.
   4. Damage to soil, roots, bark, trunk, limbs, branches, and foliage.
   5. Prevent unauthorized cutting, breaking, skinning and bruising of roots, branches, and bark.

1.04 SUBMITTALS

A. Procedural proposal for tree and plant protection, describe methods of protection, and stabilization, provide drawings and supporting documentation as directed.

B. Contractor's Condition Inspection; include written report and color photographs.

1.05 PROJECT CONDITIONS

A. Install protection during initial mobilization at the Work site, and maintain until substantial completion.

B. If, in the opinion of the Owner's arborist, additional protection is required, the Contractor shall install additional fencing as directed and without cost to the Owner.

C. The location and requirements for additional fencing shall be determined by the Owner's arborist prior to, and at any time during the course of the Work.

D. Fencing:
   1. Fencing shall be installed at the tree and plant protection areas as detailed on Plans, or as directed by the Owner's Authorized Representative.
   2. Tree and plant protection fences shall remain in place until all Work is completed and shall not be removed or relocated without the approval of the Owner's Authorized Representative.

E. Driving and Parking:
   1. Not permitted off paved surfaces without the approval of the Owner's Authorized Representative.
   2. When approved, the Contractor shall place plywood of sufficient thickness and width to support vehicles and prevent rutting on the area to be driven on.
   3. Care shall also be taken with respect to existing lawn sprinkler systems.

F. Storage of materials and Debris: Not permitted off paved surfaces.

PART 2 PRODUCTS

2.01 MANUFACTURED COMPONENTS

A. Chain Link Fencing: 11 gage galvanized chain link, six feet. tall, and 1.5 inch inside diameter galvanized steel line posts and 2.5 inch inside diameter corner posts, provide lockable gates as necessary.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Inspect trees, plants, and groundcovers, document existing conditions prior to installation of protection.

3.02 EXECUTION

A. Pruning and Cutting of Roots, Branches and Foliage:
   1. Review conditions with Architect or Owner prior to need for work, and proceed as directed.
   2. All pruning to be done by Owner's landscape maintenance personnel or ISA Certified arborist under the direction of Owner's Landscape Management Department.
   3. Perform pruning and cutting with sharp instruments intended for the purpose; do not break or chop.

B. Root Cuttings:
   1. Carefully and cleanly cut roots and branches of trees indicated to be left standing where such roots and branches obstruct new construction.
   2. Protect exposed roots with wet burlap until they can be covered with soil.

C. Excavation and Trenching Within Drip Lines:
   1. Permitted where indicated, and at other specifically approved locations.
   2. Tunnel under or around roots by hand digging or boring.
   3. Do not cut main lateral roots and tap roots over one inch diameter; cut smaller roots which interfere with installation of new Work.
   4. Do not allow exposed roots to dry out before permanent backfill is placed; provide temporary earth cover, or pack with peat moss and wrap with burlap.
   5. Water and maintain roots in moist condition and temporarily support and protect from damage until permanently relocated and covered with backfill.

D. Existing Grading: Maintain within drip line of trees and plants unless otherwise indicated on the drawing and approved by the Owner's Authorized Representative.

E. Tree Protection:
   1. Provide temporary fence complying with Section 01 51 00 for protection of trees to remain.
   2. Extend fencing ten feet beyond dripline, except where greater distance is required for protection of Elm trees.
   3. Prevent entry into protected areas except as authorized in writing by the Owner's Authorized Representative.

3.03 REPAIR AND REPLACEMENT OF TREES AND PLANTS

A. Repair trees or shrubs damaged by construction operations as directed by the Owner.

B. Make repairs promptly after damage occurs to prevent progressive deterioration of damaged trees.

C. Damaged Trees, Shrubs and Groundcover:
   1. Replace where Owner's Authorized Representative determines restoration to normal growth pattern is not possible; plant and maintain as directed.
   2. Replacement trees up to 13 inches caliper and shrubs up to 4 feet tall: Same size as damaged tree or shrub, species selected by the Owner's Authorized Representative.
   3. Trees over 13 inch caliper and shrubs greater than 4 feet tall: Compensate Owner as determined by an acceptable consulting arborist registered with the American Society of Consulting Arborists.
   4. Replacement groundcovers: Same size and quality as damaged species selected by Owner's Authorized Representative.

END OF SECTION 01 56 39

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Summary:
   1. Product options.
   2. Owner-furnished products.
   3. Product delivery, storage and handling.

1.02 PRODUCTS

A. Products:
   1. New material, machinery, components, equipment, fixtures, and systems forming the Work, but does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work.
   2. Products may also include existing materials or components specifically identified for reuse.

B. Use interchangeable components of the same manufacture for similar components.

C. Unless otherwise specified, all material and equipment shall be new; free from defects impairing strength, durability, and appearance; of current manufacture.

D. Items specified shall be considered minimum as to quality, function, capacity, and suitability for application intended.

E. Items incorporated into the Work shall conform to applicable specifications and standards designated, and shall be of size, make, type, and quality specified.

F. Design, fabricate, and assemble in accordance with current best engineering, industry, and shop practices.

G. Manufacture like parts of duplicate units to standard size and gauge to make them interchangeable.

H. Two or more items of the same kind shall be identical and made by the same manufacturer.

1.03 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

C. Products Specified by Naming One [or More] Manufacturer[s]: Products of manufacturer[s] named and meeting specifications, no options or substitutions allowed.

D. Substitution Procedure: Under Section 01 25 00.

1.04 REUSE OF EXISTING PRODUCTS

A. Except as specifically indicated or specified, materials and equipment removed from existing construction shall not be used in the completed Work.

B. For material and equipment specifically indicated or specified to be reused in the Work:

1. Use care in removal, handling, storage, and reinstallation to assure proper function in the completed Work.
2. Arrange for transportation, storage, and handling of products which require off-site storage, restoration, or renovation.
3. Remove and reinstall mechanical units, vents, guys, antennae, and electrical and grounding wires or conduits.

1.05 OWNER FURNISHED PRODUCTS

A. Designate delivery dates of Owner-furnished items in the construction schedule.

B. Receive, unload, store and handle Owner-furnished items at the site; protect from damage.

1.06 DELIVERY, STORAGE AND HANDLING

A. Transport, handle, store and protect products in accordance with manufacturer's instructions.

B. Arrange deliveries in accordance with construction schedules; coordinate to avoid conflict with Work and site conditions.

C. Deliver and store products in undamaged condition in manufacturer's original containers or packaging with identifying labels intact and legible.

D. Inspect shipments to assure compliance with Contract Documents and reviewed submittals, and that products are undamaged.

E. Prevent soiling or damage to products or packaging.

F. Interior Storage: Maintain required temperature and humidity ranges. Verify that Owner furnished storage meets product manufacturer's requirements.

G. Exterior Storage:
   1. Store materials above ground to prevent soiling and/or moisture infiltration.
   2. Cover materials with waterproof breathable sheet coverings; provide adequate ventilation.
   3. All storage locations to be approved in advance by the Owner.

H. Arrange storage to provide access for inspection.

I. Coordinate with Owner’s Authorized Representative all on-site storage activities.

J. Provide for security of stored products.

END OF SECTION 01 60 00

SECTION 01 73 29

CUTTING AND PATCHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Requirements and limitations for cutting and patching of Work.

1.02 RELATED SECTIONS

A. Section 01 25 00, Product Substitution Procedures.

B. Section 01 33 23, Shop Drawings, Product Data, Samples

1.03 SUBMITTALS

A. Submit written request in advance of cutting or alteration which affects:
   1. Structural integrity of any element of the Work.
   2. Efficiency, maintenance, or safety of any operational element.
   3. Visual qualities of sight exposed elements.
   4. Work of Owner or separate contractor.

B. Include in request:
   1. Identification of project.
   2. Location and description of affected work.
   3. Necessity for cutting or alteration.
   4. Description of proposed work, and products to be used.
   5. Alternatives to cutting and patching.
   6. Effect on work of Owner or separate contractor.
   7. Written permission of affected separate contractor.
   8. Date and time work will be executed.

PART 2 PRODUCTS

2.01 MATERIALS

A. Primary Products: Those required for original installation.

B. Product Substitution: For any proposed change in materials, submit request for substitution under provisions of Section 01 25 00.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.

B. After uncovering existing work, inspect conditions affecting performance of Work.

C. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

A. Provide temporary supports to ensure structural integrity of the Work.

B. Provide devices and methods to protect other portions of the Work from damage.

C. Provide protection from elements for areas which may be exposed by uncovering work.

3.03 CUTTING AND PATCHING

A. Execute cutting, fitting and patching to complete work.

B. Fit products together, to integrate with other work.

C. Remove and replace defective or non-conforming work.

D. Provide openings in the work for penetration of mechanical and electrical work.

3.04 PERFORMANCE

A. Execute work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.

B. Cut rigid materials using masonry saw or core drill. Pneumatic tools are not allowed without prior approval from Owner's Authorized Representative.

C. Restore work with new products in accordance with requirements of Contract Documents.

D. At penetrations of fire rated walls, partitions, ceiling or floor construction, completely seal voids with approved fire rated material, to full thickness of the penetrated element.

E. Refinishing:
   1. Refinish surfaces to match adjacent finish.
   2. For continuous surfaces, refinish to nearest intersection or natural break.
   3. For an assembly, refinish entire unit.

END OF SECTION 01 73 29

SECTION 01 74 00

CLEANING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Related requirements specified elsewhere, cleaning for specific products or work: Specification section for that work.

B. Maintain premises and public properties free from accumulations of waste, debris, and rubbish, caused by operations.

C. At completion of Work remove waste materials, rubbish, tools, equipment, machinery and surplus materials, and clean all sight-exposed surfaces; leave project clean and ready for occupancy.

1.02 QUALITY ASSURANCE

A. Standards: Maintain project in accord with applicable safety and insurance standards.

B. Hazard Control:
   1. Store volatile wastes in covered metal containers.
   2. Provide adequate ventilation during use of volatile or noxious substances.

1.03 MATERIALS

A. Use only cleaning materials recommended by manufacturer of surface to be cleaned.

B. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

1.04 DURING CONSTRUCTION:

A. Wet down dry materials and rubbish to lay dust and prevent blowing dust.

B. At reasonable intervals during progress of Work clean site and public properties, and dispose of waste materials, debris and rubbish.

C. Provide on-site containers for collection of waste materials, debris and rubbish.

D. Remove waste materials, debris and rubbish from site and legally dispose of at public or private dumping areas off Owner's property.

E. Vacuum clean interior building areas when ready to receive finish painting, and continue vacuum cleaning on an as-needed basis until project is ready for Substantial Completion or occupancy.

F. Handle materials in a controlled manner with as few handlings as possible; do not drop or throw materials from heights.

1.05 FINAL CLEANING

A. Employ experienced workers, or professional cleaners, for final cleaning.

B. In preparation for Substantial Completion or occupancy, conduct final inspection of sight-exposed interior and exterior surfaces, and of concealed spaces.

C. Remove grease, dust, dirt, stains, labels, and other foreign materials from exposed interior and exterior finished surfaces.

D. Remove putty, paint, labels, lubricants, etc., from windows, mirrors, and sash, and then polish, taking care not to scratch glass.

E. Vacuum carpeting (shampoo where required), removing debris and excess nap.

F. Repair, patch and touch up marred surfaces to specified finish, to match adjacent surfaces.

G. Replace air filters where units were operated during construction.

H. Maintain cleaning until project, or portion thereof, is occupied by Owner.

END OF SECTION 01 74 00

SECTION 01 77 00

CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 DESCRIPTION

A. The requirements specified in this section relate to all Contractors individually performing under these Contract Documents:
   1. Project Record Documents.
   2. Final review and payment.

B. Related work specified elsewhere:
   1. OSU General Conditions.
   2. Shop Drawings, Product Data and Samples, Section 01 33 23.

1.02 PROJECT RECORD DOCUMENTS

A. The Project Record Documents shall be organized to include the following information:
   1. Table of Contents
   2. Project Team List
   3. Specifications (Including Addenda and Change Orders)
   4. Drawings
   5. Inspection Reports, as applicable
   6. Signed Warranty(ies)
   7. Maintenance Instructions

B. Draft Project Record Documents shall be submitted for review upon 75% completion of the Work.

C. Project Record Documents shall be submitted electronically to the Owner. Hard copies will not be accepted.

D. The project team list shall include the name, address, and phone number of the Owner, Contractor, Inspector, Subcontractors, and the materials manufacturers.

E. Legibly mark each Specification section to indicate actual as-built condition indicating changes in the Work made by addenda or change order or actual materials used and actual manufacturer(s) used.

F. Maintain current and accurate as-built mark-ups during construction and make available to Owner’s Authorized Representative upon request.

G. Legibly mark the drawings to indicate actual as-built conditions indicating changes in the Work made by addenda or change order or actual conditions which differ from the drawings.

H. Redraw or provide new drawings as required for a complete as-built set of drawings. The Contractor shall maintain current and accurate as-built mark-ups during construction and make available to Owner’s Authorized Representative.

I. Include inspection reports if applicable.

J. Include, in a single section, all copies of the Project’s labor and material warranties clearly marked to identify the Owner's responsibilities under the terms of each warranty and the section of Work that each warranty covers. One set must be clearly marked as containing original documents.

K. In the case of an elevator installation, the Contractor's and manufacturer's warranty shall provide for the Owner's right to respond to emergency/car failure situations for the purpose of extricating individuals trapped in the elevator.

L. Include maintenance instructions complete with technical information and name, address, and phone number of the Contractor(s) and manufacturer(s) of each material and product.

1.03 FINAL REVIEW AND PAYMENT

A. Prior to completion, the Contractor shall inspect the Work and make a Punch-list noting all items that are incomplete and/or incorrect.

B. The Contractor shall notify all Subcontractors in writing of incomplete and/or incorrect items. Notify far enough in advance of the completion date that the Work can be completed on schedule. Said Work shall be immediately corrected.

C. Should conditions prevail which prohibit some elements of the Work from being accomplished, but the work-in-place will perform the primary function (i.e., painting cannot be completed due to high moisture content of masonry walls.) the Contractor shall record the reason with this Punch-list item requesting temporary delay in completion from the Owner in writing.

D. Notify the Owner in writing that all items are completed and ready for final review or else that the Work product is fully usable, but some listed deficiencies remain to be completed. Submit all record documents at this time.

E. The Owner will review all documents. When the documents include a Contractor's request for delay in completion, the Owner will review all Work which is certified as complete to the best knowledge of the Contractor. The Owner will also review the listed incomplete Work and assign a value to such uncompleted work.

F. The Contractor shall make the required corrections to the Work expeditiously. A letter will be addressed to the Contractor informing the Contractor of the project status.

G. When Contract closeout procedures are completed and all Punch-list deficiencies have been corrected, provide Owner with final corrected Project Record Documents based on Owner’s preliminary review. Correct Project Record Documents shall be in electronic format.

H. Final Completion by the Owner will be documented and the Contractor will receive written notice of acceptance of the Work and notification that final payment may be billed and released.

I. All warranties shall commence and become effective beginning on the date of Substantial Completion.

END OF SECTION 01 77 00

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of a building or structure.
2. Demolition and removal of selected site elements.
3. Repair procedures for selective demolition operations.
4. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. Section 01 10 00 "Summary" for use of the premises and Owner occupancy requirements.
2. Section 01 14 00 "Work Restrictions" for restrictions on use of the premises due to Owner or tenant occupancy.
3. Section 01 32 00 "Construction Progress Documentation" for preconstruction photographs taken before selective demolition.
4. Section 01 50 00 "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for selective demolition operations.
5. Section 01 73 00 "Execution" for cutting and patching procedures.
6. Section 01 74 19 "Construction Waste Management and Disposal" for disposal of demolished materials.

1.2 DEFINITIONS

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

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. 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.

1.3 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

1.4 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00"Project Management and Coordination." Review methods and procedures related to selective demolition including, but not limited to, the following:

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.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

1. Include lists of completed projects with project names and addresses, names and addresses of Architects and Owners, and other information specified.

B. Proposed Environmental Protection, Dust-Control and Noise-Control Measures: Submit report, including drawings, that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.

C. 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 and duration of interruption.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Locations of temporary partitions and means of egress.
6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
7. Means of protection for items to remain and items in path of waste removal from building.

D. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged and deliver to Owner prior to start of demolition.

E. Predemolition Photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective 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 indicated that existing warranties are still in effect after completion of selective demolition.

1.6 CLOSEOUT SUBMITTALS

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

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

C. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1. Comply with submittal requirements in Section 01 74 19 "Construction Waste Management and Disposal."

1.7 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Professional Engineer Qualifications: Comply with Section 01 40 00 "Quality Requirements."

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

D. Standards: Comply with ANSI A10.6 and NFPA 241.

1.8 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. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

1. Comply with requirements specified in Section 01 14 00 "Work Restrictions."

B. Owner assumes no responsibility for condition of areas to be selectively demolished.

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

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

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

D. Storage or sale of removed items or materials on-site will not be permitted.

E. 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.

1.9 WARRANTY

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

1. If possible, retain original Installer or fabricator to patch the exposed Work listed below that is damaged during selective demolition. If it is impossible to engage original Installer or fabricator, engage another recognized experienced and specialized firm.

a. Processed concrete finishes.
b. Ornamental metal.
c. Preformed metal panels.
d. Roofing.
e. Firestopping.
f. Window wall system.
g. HVAC enclosures, cabinets, or covers.

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.

PART 2 - PRODUCTS

2.1 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 ANSI/ASSE A10.6 and NFPA 241.

2.2 REPAIR MATERIALS

A. Use repair materials identical to existing materials.

1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
2. Use materials whose installed performance equals or surpasses that of existing materials.

B. Comply with material and installation requirements specified in individual Specification Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Engage a professional engineer to survey 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 demolition operations.

F. Survey of Existing Conditions: Record existing conditions by use of measured drawings,preconstruction photographs and templates.

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

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Maintain services indicated to remain and protect them against damage during selective demolition operations.

1. Comply with requirements for existing services/systems interruptions specified in Section 01 14 00 "Work Restrictions."

B. Existing Services/Systems to be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated 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. Provide minimum 48 hours' notice when requesting shut-off.
2. Arrange to shut off indicated 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 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.
    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.
    h. Fire Suppression System Partial or Complete Removal: Arrange for bypass of area to be removed so that overall building fire suppression system remains in operation. If continuous operation is not possible, coordinate with local Fire authorities; maintain firewatch during removal operations and until system can be restored to working order. Maintain fire extinguishers on the site.

C. Ballasts: If ballast is not labeled "No PCBs," or if the label is illegible, contact a ballast recycler for disposal.

D. Mercury-Containing Devices: Mercury-containing devices include thermostats, silent switches, mechanical switches and relays or contacts. Dispose of these devices with an appropriate recycler.

E. Nickel-Cadmium and Lead-Acid Batteries: Exit signs, emergency lighting units, alarm systems, smoke detectors and carbon-monoxide detectors may contain nickel-cadmium or lead-acid. Arrange with an appropriate recycler for disposal.

F. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

G. Utility Requirements: Refer to Divisions 22 and 26 Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.3 PREPARATION

A. Dangerous Materials: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.

1. Pest Control: Employ a certified, licensed exterminator to treat building and to control rodents and vermin before and during selective demolition operations.

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.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
2. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
3. Protect existing site improvements, appurtenances, and landscaping to remain.
4. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.

C. Temporary Facilities: 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."

D. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.

E. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.

F. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, and structural supports to preserve stability and prevent movement, settlement, or collapse of construction indicated 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.

3.4 POLLUTION CONTROLS

A. Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.

1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
2. Wet mop floors to eliminate trackable dirt and wipe down walls and doors of demolition enclosure. Vacuum carpeted areas.

B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

3.5 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, to minimize disturbance of adjacent surfaces. 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 fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly. Comply with requirements in Section 01 74 19 "Construction Waste Management and Disposal."
10. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.

B. Existing Facilities: Comply with building manager's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.

C. Removed and Salvaged Items: Comply with the following:

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 designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items: Comply with the following:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
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.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.

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

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

D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.{RESILIENT FLOOR COVERINGS}

1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.

E. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

3.7 PATCHING AND REPAIRS

A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.

B. Patching: Comply with Section 01 73 00 "Execution."

C. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

1. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.

D. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

E. Floors and Walls: Where walls or partitions that are demolished extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
2. Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
3. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

F. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.8 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

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 Section 01 74 19 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

D. 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 Section 01 74 19 "Construction Waste Management and Disposal."

1. Comply with requirements specified in Section 01 74 19 "Construction Waste Management and Disposal."

3.9 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.

END OF SECTION 02 41 19

SECTION 03 54 16 - HYDRAULIC CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes hydraulic-cement-based, polymer-modified, self-leveling underlayment for application below interior floor coverings.

1.2 COORDINATION

A. Coordinate application of underlayment with requirements of floor-covering products and adhesives, to ensure compatibility of products.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: Signed by manufacturers of underlayment and floor-covering systems certifying that products are compatible.

C. Field Test Results: Floor surface flatness and levelness measurements to determine compliance with specified tolerances.

D. Preconstruction Test Reports: Prior to the installation of the underlayment, provide test results indicating slab moisture vapor emission meets the requirements of the finish flooring manufacturer in accordance with ASTM F 2170.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Installer who is approved by manufacturer and factory trained for application of underlayment products required for this Project.

B. Product Compatibility: Manufacturers of underlayment and floor-covering systems certify in writing that products are compatible.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.

1. Place hydraulic-cement-based underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F (10 and 27 deg C).

PART 2 - PRODUCTS

2.1 HYDRAULIC-CEMENT-BASED UNDERLAYMENTS

A. Hydraulic Cement Underlayment: Hydraulic-cement-based, polymer-modified, self-leveling product that can be applied in minimum uniform thickness of 1/4 inch (6 mm) and that can be feathered at edges to match adjacent floor elevations.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. ARDEX GmbH; K-15 Self-Leveling Underlayment Concrete.
    b. BASF, Master Builders Solutions; MasterTop 111SL.
    c. L&M Construction Chemicals, Inc.; Levelex.
    d. MAPEI Corporation; Ultraplan 1 Plus.

2. Cement Binder: ASTM C 150, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C 219.
3. Compressive Strength: Not less than 4000 psi (27.6 MPa) at 28 days when tested according to ASTM C 109/C 109M.
4. Underlayment Additive: Resilient-emulsion product of underlayment manufacturer, formulated for use with underlayment when applied to substrate and conditions indicated.

B. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm); or coarse sand as recommended by underlayment manufacturer.

1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.

C. Water: Potable and at a temperature of not more than 70 deg F (21 deg C).

D. Reinforcement: For underlayment applied to wood substrates, provide galvanized metal lath or other corrosion-resistant reinforcement recommended in writing by underlayment manufacturer.

E. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.

1. VOC Content: Provide coating with VOC content of 200 g/L or less.

F. Corrosion-Resistant Coating: Recommended in writing by underlayment manufacturer for metal substrates.

1. VOC Content: Provide coating with VOC content of 250 g/L or less.

G. Surface Sealer: Designed to reduce porosity as recommended by manufacturer for type of floor covering to be applied to underlayment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for conditions affecting performance.

1. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Prepare and clean substrate according to manufacturer's written instructions.

B. Provide clean, dry, neutral-pH substrate for underlayment application.

1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
2. Fill substrate voids to prevent underlayment from leaking.

C. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond. Do not use solvents.

1. Moisture Testing: Perform tests recommended by flooring manufacturer, but not less stringent than one of the following:

a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/100 sq. m) in 24 hours.

b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.

2. Alkalinity and Adhesion Testing: Perform tests recommended by flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.

D. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

3.3 APPLICATION

A. General: Mix and apply underlayment components according to manufacturer's written instructions.

1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.
2. Coordinate application of components to provide optimum adhesion to substrate and between coats.
3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Apply underlayment to produce uniform, level surface.

1. Apply a final layer without aggregate to product surface.
2. Feather edges to match adjacent floor elevations.

D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.

E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.

F. Apply surface sealer at rate recommended by manufacturer.

G. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

3.4 FIELD QUALITY CONTROL

A. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 24 hours of finishing.

3.5 PROTECTION

A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION 03 54 16

SECTION 04 20 00 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Clay face brick; to match existing.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry-joint reinforcement.
5. Ties and anchors.
6. Embedded flashing.

B. Products Installed but not Furnished under This Section:

1. Steel lintels in unit masonry.
2. Steel shelf angles for supporting unit masonry.
3. Cavity wall insulation.

C. Related Requirements:

1. Section 07 62 00 "Sheet Metal Flashing and Trim" for [exposed] sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Verification: For each type and color of the following:

1. Clay face brick, in the form of straps of five or more bricks.
2. Special brick shapes.

3. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project.
4. Weep holes.
5. Accessories embedded in masonry.

1.4 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Qualification Data: For testing agency.

C. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include data on material properties.
b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
c. For exposed brick, include test report for efflorescence according to ASTM C 67.
d. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.

2. Cementitious materials. Include name of manufacturer, brand name, and type.
3. Mortar admixtures.
4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
5. Grout mixes. Include description of type and proportions of ingredients.
6. Reinforcing bars.
7. Joint reinforcement.

D. Mix Designs: For each type of mortar[and grout]. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 01 40 00 "Quality Requirements" for mockups.

1. Build sample panels for typical exterior wall in sizes approximately 48 inches (1200 mm) long by 48 inches (1200 mm) high[by full thickness].
2. Build sample panels facing south.
3. Where masonry is to match existing, build panels adjacent and parallel to existing surface.
4. Clean one-half of exposed faces of panels with masonry cleaner indicated.
5. Protect approved sample panels from the elements with weather-resistant membrane.
6. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.

    a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless Architect specifically approves such deviations in writing.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls, and hold cover securely in place.
2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe, and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.
2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

2.3 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work[and will be within 20 feet (6 m) vertically and horizontally of a walking surface].

2.4 MASONRY LINTELS

A. General: Provide one of the following:

B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.5 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.

4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Clay Face Brick: Facing brick complying with ASTM C 216.

1. Grade: SW.
2. Type: FBS.
3. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 4150 psi (28.61 MPa) .
4. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested according to ASTM C 67.
5. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
6. Where shown to "match existing," provide face brick matching color range, texture, and size of existing adjacent brickwork.

2.6 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979/C 979M. Use only pigments with a record of satisfactory performance in masonry mortar.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Davis Colors; True Tone Mortar Colors.
b. Lanxess Corporation; Bayferrox Iron Oxide Pigments.
c. Solomon Colors, Inc.; SGS Mortar Colors.

E. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.

F. Aggregate for Grout: ASTM C 404.

G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Products: Subject to compliance with requirements, provide one of the following:

a. BASF Corporation-Construction Systems.
b. Euclid Chemical Company (The); an RPM company; Accelguard 80.
c. Grace Construction Products; W.R. Grace & Co. -- Conn.; Morset.

2.7 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dur-O-Wal; a Hohmann & Barnard company; D/A 810, D/A 812 or D/A 817.
b. Heckmann Building Products, Inc.; No. 376 Rebar Positioner.
c. Hohmann & Barnard, Inc; #RB or #RB-Twin Rebar Positioner.
d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

C. Masonry-Joint Reinforcement, General: ASTM A 951/A 951M.

1. Interior Walls: Mill- galvanized carbon steel.
2. Exterior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side Rods: 0.187-inch (4.76-mm) diameter.
4. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.
5. Wire Size for Veneer Ties: 0.148-inch (3.77-mm) diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.
7. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.

D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder or truss type with single pair of side rods.

2.8 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches (38 mm) into veneer but with at least a 5/8-inch (16-mm) cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Mill-Galvanized, Carbon-Steel Wire: ASTM A 1064/A 1064M, with ASTM A 641/A 641M, Class 1 coating.
2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 1064/A 1064M, with ASTM A 153/A 153M, Class B-2 coating.
3. Galvanized-Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 (Z180) zinc coating.
4. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
5. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.
6. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
7. Stainless-Steel Bars: ASTM A 276 or ASTM A 666, Type 304.

C. Corrugated-Metal Ties: Metal strips not less than 7/8 inch (22 mm) wide with corrugations having a wavelength of 0.3 to 0.5 inch (7.6 to 12.7 mm) and an amplitude of 0.06 to 0.10 inch (1.5 to 2.5 mm) made from 0.030-inch- (0.76-mm-) thick steel sheet, galvanized after fabrication.

D. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches (100 mm) wide.

1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches (50 mm) long may be used for masonry constructed from solid units.
2. Where wythes are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches (32 mm).
3. Wire: Fabricate from 3/16-inch- (4.76-mm-) diameter, hot-dip galvanized steel wire. Mill-galvanized wire ties may be used in interior walls unless otherwise indicated.

E. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Tie Section: Triangular-shaped wire tie made from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.

F. Partition Top Anchors: 0.105-inch- (2.66-mm-) thick metal plate with a 3/8-inch- (9.5-mm-) diameter metal rod 6 inches (152 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

G. Rigid Anchors: Fabricate from steel bars 1-1/2 inches (38 mm) wide by 1/4 inch (6.35 mm) thick by 24 inches (610 mm) long, with ends turned up 2 inches (51 mm) or with cross pins unless otherwise indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.

H. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist a 100-lbf (445-N) load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch (1.5 mm).
2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.075-inch- (1.90-mm-) thick steel sheet, galvanized after fabrication.
3. Fabricate wire ties from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized-steel wire unless otherwise indicated.
4. Contractor's Option: Unless otherwise indicated, provide any of the adjustable masonry-veneer anchors specified.
5. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a rib-stiffened, sheet metal anchor section with screw holes top and bottom, with projecting tabs having holes for inserting vertical legs of wire tie formed to fit anchor section.

    a. Products: Subject to compliance with requirements, provide one of the following:

        1) Heckmann Building Products, Inc.; 213 with 282.
        2) Hohmann & Barnard, Inc; HB-200-X.
        3) Wire-Bond; RJ-711.

6. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a sheet metal anchor section, 1-1/4 inches (32 mm) wide by 6 inches (152 mm) long, with screw holes top and bottom and with raised rib-stiffened strap, 5/8 inch (16 mm) wide by 3-5/8 inches (92 mm) long, stamped into center to provide a slot between strap and base for inserting wire tie.

    a. Products: Subject to compliance with requirements, provide one of the following:

        1) Heckmann Building Products, Inc.; 315-D with 316.
        2) Hohmann & Barnard, Inc; DW-10HS.
        3) Wire-Bond; 1004, Type III.

7. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a corrosion-resistant, self-drilling, eye-screw designed to receive wire tie. Eye-screw has spacer that seats directly against framing and is same thickness as sheathing and has gasketed washer head that covers hole in sheathing.

    a. Products: Subject to compliance with requirements, provide one of the following:

        1) Heckmann Building Products, Inc.; Pos-I-Tie.
        2) Hohmann & Barnard, Inc; 2-Seal Tie.
        3) Wire-Bond; SureTie.

2.9 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with Section 07 62 00 "Sheet Metal Flashing and Trim" and as follows:

1. Stainless Steel: ASTM A 240/A 240M or ASTM A 666, Type 304, 0.016 inch (0.40 mm) thick.

2. Fabricate continuous flashings in sections 96 inches (2400 mm) long minimum, but not exceeding 12 feet (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with ribs at 3-inch (76-mm) intervals along length of flashing to provide an integral mortar bond.

    a. Products: Subject to compliance with requirements, provide one of the following:

        1) Cheney Flashing Company; Cheney 3-Way Flashing (Sawtooth).
        2) Keystone Flashing Company, Inc; Keystone 3-Way Interlocking Thruwall Flashing.

4. Fabricate through-wall flashing with drip edge where indicated. Fabricate by extending flashing 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
5. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch (19 mm) at exterior face of wall and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.
6. Fabricate metal drip edges from stainless steel. Extend at least 3 inches (76 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
7. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches (76 mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.
8. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.
9. Solder metal items at corners.

B. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Asphalt-Coated Copper Flashing: 5-oz./sq. ft. (1.5-kg/sq. m) copper sheet coated with flexible asphalt. Use only where flashing is fully concealed in masonry.

    a. Products: Subject to compliance with requirements, provide one of the following:

        1) Advanced Building Products Inc.; Cop-R-Cote.
        2) Hohmann & Barnard, Inc; Coated Copper Flashing.

2. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.030 inch (0.76 mm).

    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

        1) Advanced Building Products Inc.; Peel-N-Seal.
        2) Carlisle Coatings & Waterproofing Inc; CCW-705-TWF Thru-Wall Flashing.
        3) Grace Construction Products; W.R. Grace & Co. -- Conn.; Perm-A-Barrier Wall Flashing.

4) Heckmann Building Products, Inc.; No. 82 Rubberized-Asphalt Thru-Wall Flashing.
5) Hohmann & Barnard, Inc; Sando-Seal.
6) Polyguard Products, Inc.; [Polyguard 300][Polyguard 400].
7) W.R. Meadows, Inc; Air-Shield Thru-Wall Flashing.

b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

3. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.030 inch (0.76 mm).

a. Products: Subject to compliance with requirements, provide one of the following:

1) DuPont Building Innovations: E. I. du Pont de Nemours and Company; DuPont Flashing Tape.
2) Grace Construction Products; W.R. Grace & Co. -- Conn.; Vycor Butyl Self Adhered Flashing.
3) Protecto Wrap Company; BT-25 XL.
4) Raven Industries, Inc; Fortress Flashshield.

b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

4. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Du Pont; Thru-Wall Flashing.
2) Hohmann & Barnard, Inc; Flex-Flash.
3) Hyload, Inc.; Hyload Cloaked Flashing System.
4) Mortar Net USA, Ltd; Total Flash.

b. Monolithic Sheet: Elastomeric thermoplastic flashing, 0.040 inch (1.02 mm) thick.
c. Self-Adhesive Sheet: Elastomeric thermoplastic flashing, 0.025 inch (0.64 mm) thick, with a 0.015-inch- (0.38-mm-) thick coating of adhesive.
d. Self-Adhesive Sheet with Drip Edge: Elastomeric thermoplastic flashing, 0.025 inch (0.64 mm) thick, with a 0.015-inch- (0.38-mm-) thick coating of rubberized-asphalt adhesive. Where flashing extends to face of masonry, rubberized-asphalt coating is held back approximately 1-1/2 inches (38 mm) from edge.
e. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

5. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D 4637/D 4637M, 0.040 inch (1.02 mm) thick.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Carlisle Coatings & Waterproofing Inc; Pre-Kleened EPDM Thru-Wall Flashing.
2) Firestone Specialty Products; FlashGuard.
3) Heckmann Building Products, Inc.; No. 81 EPDM Thru-Wall Flashing.
4) Hohmann & Barnard, Inc; EPDM Flashing.

C. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge.
4. Where flashing is fully concealed, use metal flashing or flexible flashing.

D. Solder and Sealants for Sheet Metal Flashings: As specified in Section 07 62 00 "Sheet Metal Flashing and Trim."

1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
2. Elastomeric Sealant: ASTM C 920, chemically curing [urethane] [polysulfide] [silicone] sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and remain watertight.

E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

F. Termination Bars for Flexible Flashing: Stainless steel bars 0.075 inch by 1 inch (1.90 mm by 25 mm).

G. Termination Bars for Flexible Flashing: Stainless-steel sheet 0.019 inch by 1-1/2 inches (0.48 mm by 38 mm) with a 3/8 inch (10-mm) sealant flange at top.

H. Termination Bars for Flexible Flashing: Aluminum sheet 0.064 inch by 1-1/2 inches (1.63 mm by 38 mm) with a 3/8-inch (10-mm) sealant flange at top.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene,urethane or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).

D. Weep/Cavity Vent Products: Use one of the following unless otherwise indicated:

1. Wicking Material: Absorbent rope, made from cotton or UV-resistant synthetic fiber, 1/4 to 3/8 inch (6 to 10 mm) in diameter, in length required to produce 2-inch (50-mm) exposure on exterior and 18 inches (450 mm) in cavity. Use only for weeps.
2. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, 3/8-inch (9-mm) OD by 4 inches (100 mm) long.
3. Rectangular Plastic Weep/Vent Tubing: Clear butyrate, 3/8 by 1-1/2 by 3-1/2 inches (9 by 38 by 89 mm) long.
4. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe, in color selected from manufacturer's standard.

    a. Products: Subject to compliance with requirements, provide one of the following:

        1) Advanced Building Products Inc.; Mortar Maze Cell Vent.
        2) Heckmann Building Products, Inc.; No. 85 Cell Vent.
        3) Hohmann & Barnard, Inc; QV Quadro-Vent.
        4) Wire-Bond; Cell Vent.

5. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe; in color selected from manufacturer's standard.

    a. Products: Subject to compliance with requirements, provide one of the following:

        1) Advanced Building Products Inc.; Mortar Break Weep Mesh.
        2) CavClear/Archovations, Inc.; CavClear Weep Vents.
        3) Keene Building Products; Driwall Weep Vents 025.
        4) Mortar Net USA, Ltd; Mortar Net Weep Vents.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:

    a. Advanced Building Products Inc.; Mortar Break.
    b. CavClear/Archovations, Inc.; CavClear Masonry Mat.
    c. Heckmann Building Products, Inc.; Weep-Thru Mortar Deflector.

d. Hohmann & Barnard, Inc; Mortar Trap.
e. Mortar Net USA, Ltd; Mortar Net.
f. Wire-Bond; Cavity Net.

2. Configuration: Provide one of the following:

a. Strips, full depth of cavity and 10 inches (250 mm) high, with dovetail-shaped notches 7 inches (175 mm) deep that prevent clogging with mortar droppings.
b. Strips, not less than 3/4 inch (19 mm) thick and 10 inches (250 mm) high, with dimpled surface designed to catch mortar droppings and prevent weep holes from clogging with mortar.
c. Sheets or strips, full depth of cavity and installed to full height of cavity.
d. Sheets or strips not less than 3/4 inch (19 mm) thick and installed to full height of cavity, with additional strips 4 inches (100 mm) high at weep holes and thick enough to fill entire depth of cavity and prevent weep holes from clogging with mortar.

2.11 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.
3. For exterior masonry, use portland cement-lime mortar.
4. For reinforced masonry, use portland cement-lime mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated[or needed to provide required compressive strength of masonry].

1. For masonry below grade or in contact with earth, use Type M.
2. For reinforced masonry, use Type M.
3. For mortar parge coats, use Type S.
4. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
5. For interior nonload-bearing partitions, Type O may be used instead of Type N.

D. Pigmented Mortar: Use colored cement product[or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products].

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Mix to match Architect's sample.
3. Application: Use pigmented mortar for exposed mortar joints with the following units:

    a. Clay face brick.

E. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
3. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested according to ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.5 mm) from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in one-third running bond; do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches (100 mm). Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.

2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch (13-mm) clearance between end of anchor rod and end of tube. Space anchors 48 inches (1200 mm) o.c. unless otherwise indicated.
3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 07 84 43 "Joint Firestopping."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow brick as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.

B. Lay solid masonry units and hollow brick with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.6 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:

1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 2.67 sq. ft. (0.25 sq. m) of wall area spaced not to exceed 24 inches (610 mm)o.c. horizontally and 16 inches (406 mm) o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches (305 mm) of openings and space not more than 36 inches (915 mm) apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches (610 mm) o.c. vertically.

    a. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) ties.
    b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) ties to allow for differential movement regardless of whether bed joints align.

2. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.

a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement with continuous horizontal wire in facing wythe attached to ties.
c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) reinforcement[with continuous horizontal wire in facing wythe attached to ties] to allow for differential movement regardless of whether bed joints align.

3. Header Bonding: Provide masonry unit headers extending not less than 3 inches (76 mm) into each wythe. Space headers not more than 8 inches (203 mm) clear horizontally and 16 inches (406 mm) clear vertically.
4. Masonry-Veneer Anchors: Comply with requirements for anchoring masonry veneers.

B. Bond wythes of cavity walls together using bonding system indicated on Drawings.

C. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

3.7 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).

1. Space reinforcement not more than 16 inches (406 mm) o.c.
2. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at[corners,] returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.8 ANCHORING MASONRY TO STRUCTURAL STEEL

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:

1. Provide an open space not less than 1 inch (25 mm) wide between masonry and structural steel unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.9 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form expansion joints in brick as follows:

1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches (100 mm) in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
2. Build flanges of factory-fabricated, expansion-joint units into masonry.
3. Build in compressible joint fillers where indicated.
4. Form open joint full depth of brick wythe and of width indicated, but not less than 1/2 inch (13 mm) for installation of sealant and backer rod specified in Section 07 92 00 "Joint Sealants."

C. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07 92 00 "Joint Sealants," but not less than 3/8 inch (10 mm).

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.10 LINTELS

A. Install steel lintels where indicated.

B. Provide masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.11 FLASHING, WEEP HOLES, AND CAVITY VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches (200 mm); with upper edge tucked under air barrier, lapping at least 4 inches (100 mm). Fasten upper edge of flexible flashing to sheathing through termination bar.
3. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
4. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.
5. Install metal drip edges with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.
6. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
7. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
8. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

D. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.

1. Use specified weep/cavity vent products to form weep holes.
2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
3. Space weep holes 24 inches (600 mm) o.c. unless otherwise indicated.
4. Space weep holes formed from plastic tubing or wicking material 16 inches (400 mm) o.c.
5. Trim wicking material flush with outside face of wall after mortar has set.

E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

F. Install cavity vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form cavity vents.

3.12 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.

E. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

G. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

H. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.

3.13 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.

3.14 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

END OF SECTION 04 20 00

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes metal fabrications.

1.2 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. 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.

1.3 ACTION SUBMITTALS

A. Product Data: Submit product data for the following:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Paint products.
3. Grout.

B. Shop Drawings: Submit shop drawings detailing the fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

1. For installed products indicated to comply with design loads, include structural analysis data, for information only, signed and sealed by the qualified professional engineer responsible for their preparation.
2. Include plans and elevations at not less than 1" to 1'-0" (1:20) scale, and include details of sections and connections at not less than 3" to 1'-0" (1:5) scale.

1.4 INFORMATIONAL SUBMITTALS

A. Welding Certificates: Copies of certificates for welding procedures and personnel.

B. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.5 QUALITY ASSURANCE

A. Fabricator/Installer Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project for a minimum of 5 years, with a record of successful in-service performance, with sufficient production capacity to produce required units without causing delay in the work.

B. Gratings Manufacturer: A manufacturer specializing in the fabrication of the type of units required who has tested the units for load-bearing strength and deflection, and has currently published load tables based on recognized test procedures.

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

D. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.3, "Structural Welding Code--Sheet Steel."
4. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

E. Sample Installation:

1. Following review of samples, construct sample installation of the following:

   a. Countertop and vanity.

2. The sample installation shall be complete with all anchors, jointing, plywood, finished countertop surfacing, lavatory bowls and supports, as shown in accordance with the final shop drawings. Sample installations shall be reviewed by the Architect for acceptance of workmanship only. Replace unsatisfactory work as directed for final acceptance. Maintain sample installations during construction as a standard for judging acceptability of countertop work. Properly finished and maintained sample installation may be retained as a portion of the completed Work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store metal fabrications in a dry, well-ventilated, weathertight place. Deliver and handle so as to prevent any type of damage to the fabricated work.

1.7 FIELD CONDITIONS

A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Allow for trimming and fitting.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance:

1. Counter Tops and Vanities: Provide countertop and vanity framing capable of withstanding the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections, or of exhibiting excessive deflections in any of the components making up the countertops and vanities:

    a. All deadloads.
    b. 500 pound live load placed on the countertop and vanity.

2. Non-Vehicular Gratings: Capable of withstanding a uniform load of 100 lbf/sq. ft. (4.79 kN/sq. m) or a concentrated load of 300 lbf (1.33 kN) on an area of 4 sq. in. (25.8 sq. cm), whichever produces the greater stress.
3. Tube Framing for Partial Height Walls: Provide tube framing for partial height walls capable of withstanding a deflection not to exceed 2L/1440 of the wall height when subjected to a positive and negative pressure of 5 psf.
4. Sliding Woodwork Door Framing: Fabricate and install framing so that, when installed, it is capable of supporting all deadloads and withstanding the live loads imposed on it from the operation of the door.
5. Vertically Folding Operable Partitions,: Fabricate and install support framing capable of supporting all deadloads and withstanding live loads imposed from functioning operations.

B. Exterior Metal Fabrications: All exterior metal fabrications shall be fabricated and installed to prevent buckling, opening up of joints and overstressing of welds and fasteners under the following temperature conditions:

1. Base fabrication on a temperature of +70 deg F at time of installation with allowance made for an exposed metal surface temperature range of -5 deg F to +180 deg F. Make all necessary adjustments and provisions for concealed expansion.

2.2 METALS, GENERAL

A. Metal Surfaces, General: For metal fabrications 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.

2.3 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304.

C. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

D. Cold Finished Steel Bars: ASTM A108, grade as selected by fabricator.

E. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500, or hot formed steel tubing complying with ASTM A 501.

F. Steel Pipe: ASTM A 53, standard weight (Schedule 40) minimum, unless otherwise indicated or required to satisfy the performance requirements; finish as follows:

1. Black finish, unless otherwise indicated.
2. Galvanized finish for exterior installations and where indicated.

G. Slotted Channel Framing: Cold-formed metal channels with continuous slot and with flanged edges returned toward web complying with MFMA-4 and fabricated from steel complying with ASTM A 1008/A 1008M. Width, depth, and metal thickness as required to suit performance requirements.

H. Malleable-Iron Castings: ASTM A 47, Grade 32510 (ASTM A 47M, Grade 22010).

I. Gray-Iron Castings: ASTM A 48, Class 30 (ASTM A 48M, Class 200), unless another class is indicated or required by structural loads.

J. Cast-in-Place Anchors in Concrete: Anchor channel type, with filler strips, manufactured from formed hot or cold rolled carbon steel channels with flange edges returned toward web, having a minimum of 2 stud, or I, anchors shop welded to the back of each channel, complying with ASTM A 1011. Provide channels, bolts, washers, and shims hot-dip galvanized per ASTM A 153/A 153M. Width, depth, and metal thickness as required to suit performance requirements.

K. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

L. Steel Bars for Gratings: ASTM A 36/A 36M.

M. Wire Rod for Grating Crossbars: ASTM A 510 (ASTM A 510M).

2.4 ALUMINUM

A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy 6063-T6.

2.5 PAINT

A. Shop Primer for Ferrous Metal: Organic zinc-rich primer, complying with SSPC-Paint 20 and compatible with topcoat.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Carboline 621; Carboline Company.
b. Aquapon Zinc-Rich Primer 97-670; PPG Paints.
c. Tneme-Zinc 90-97; Tnemec Company, Inc.

B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.6 FASTENERS

A. General: Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36.

D. Eyebolts: ASTM A 489.

E. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).

F. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

G. Wood Screws: Flat head, carbon steel, ASME B18.6.1.

H. Plain Washers: Round, carbon steel, ASME B18.22.1 (ASME B18.22M).

I. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1 (ASME B18.21.2M).

J. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

1. Interior Expansion Anchor Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Exterior Expansion Anchor Material: Alloy Group 1 or 2 stainless-steel bolts complying with ASTM F 593 (ASTM F 738M) and nuts complying with ASTM F 594 (ASTM F 836M).

K. Toggle Bolts: FS FF-B-588, tumble-wing type, class and style as needed.

2.7 GROUT

A. Non-shrink, Non-metallic Grout: Factory-packaged, non-staining, non-corrosive, non-gaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.8 CONCRETE FILL

A. Concrete Materials and Properties: Composed of ASTM C 150 Type I Portland cement, ASTM C 33 sand and coarse aggregates and potable water to produce a low slump mix suitable for placement. Grade coarse aggregate from 1/8 inch with at least 95 percent passing a 3/8 inch sieve and not more than 10 percent passing a No. 8 sieve. Fill shall be proportioned to provide a minimum 28-day compressive strength of 3000 psi (20 MPa).

2.9 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. 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.

1. Welded connections may be used where bolted connections are shown.

B. Shear and punch metals cleanly and accurately. Remove burrs.

C. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Weld corners and seams continuously along entire line of contact to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices and fasteners to secure metal fabrications rigidly in place and to support indicated loads.

F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

G. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

H. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

I. Remove sharp or rough areas on exposed traffic surfaces.

J. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous. Make up threaded connections tight so that threads are entirely concealed.

K. Hot-dip galvanize all exterior ferrous metal fabrications embedded in concrete. Hot-dip galvanize all other items where specified or shown.

1. Exterior ferrous metal fabrications are defined as those items which are indicated to be installed in areas exposed to conditions which are not controlled by the building heating and cooling systems.
2. Interior ferrous metal fabrications are defined as those items which are indicated to be installed in areas exposed to conditions which are controlled by the building heating and cooling systems.

2.10 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize exterior plates after fabrication; prime paint interior plates after fabrication.

2.11 LOOSE STEEL LINTELS

A. Fabricate loose structural-steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Furnish a minimum of 1 angle for each masonry wythe; provide two (2) angles at all openings in 8, 10 and 12 inch masonry walls and partitions. Unless otherwise indicated on the structural drawings furnish loose steel lintels as follows:

Max. Opening	Masonry Wall and Partition Thickness (inches)			
Width (Feet)	4	6	8	10 and 12
2	3-1/2 x 3-1/2 x 1/4	5 x 5 x 5/16	3-1/2 x 3-1/2 x1/4	8 x 4 x 1/2
3	3-1/2 x 3-1/2 x 1/4	5 x 5 x 5/16	3-1/2 x 3-1/2 x1/4	8 x 4 x 1/2
4	3-1/2 x 3-1/2 x 1/4	5 x 5 x 5/16	3-1/2 x 3-1/2 x1/4	8 x 4 x 1/2
5	3-1/2 x 3-1/2 x 1/4	5 x 5 x 5/16	3-1/2 x 3-1/2 x1/4	8 x 4 x 1/2
6	3-1/2 x 3-1/2 x 1/4	5 x 5 x 5/16	3-1/2 x 3-1/2 x1/4	8 x 4 x 1/2
7	3-1/2 x 3-1/2 x 1/4	5 x 5 x 5/16	3-1/2 x 3-1/2 x1/4	8 x 4 x 1/2
8	4 x 3-1/2 x 1/4	5 x 5 x 5/16	4 x 3-1/2 x1/4	8 x 4 x 5/8

B. Weld adjoining members together to form a single unit where indicated.

C. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches (200 mm), unless otherwise indicated.

D. Galvanize loose steel lintels located in exterior walls. Prime paint loose steel lintels located in interior walls.

2.12 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide machined horizontally slotted holes to receive 3/4 inch (19 mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.

B. Provide joint gaps in angles where control and expansion joints in exterior cladding skin are shown or required. Size joint gaps to match width of the masonry joints in the location of use. Provide joints in other locations, as required for fabrication only, with tight joints.

1. Provide units at corners and other transitions fabricated into one piece.

C. Galvanize shelf angles to be installed in exterior walls; prime paint shelf angles to be installed in interior walls.

D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.13 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports indicated and as necessary to complete the Work and which are not a part of the structural framework, including but not limited to framing and supports for vertically folding operable partitions, countertop and vanities, projection screens, ceiling hung televisions and cameras, tube framing for partial height walls,CMU partition head supports, and mechanical and electrical equipment.

B. Fabricate units from structural-steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

C. Supports for Operable Partitions: Fabricate by providing continuous steel shapes with attached bearing plates, anchors, and braces as required to sustain imposed loads. Drill bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

D. Supports for Sliding Woodwork Doors: Fabricate by providing continuous steel shapes with attached bearing plates, anchors, and braces as required to sustain imposed loads. Drill bottom flanges of beams to receive track hanger rods; locate holes where indicated on sliding woodwork door Shop Drawings.

E. Countertop and Vanity Framing: Custom fabricate countertop and vanity framing, using steel shapes and plates, and cold finished mild steel bars at exposed conditions, for support framing and plywood, to the thicknesses, sizes and shapes shown, and as required to produce work of adequate strength and durability, without objectionable deflections. Use proven details of fabrication, as required, to achieve proper assembly and alignment of the various components of the work.

F. Galvanize miscellaneous framing and supports at exterior locations; prime paint miscellaneous framing and supports at interior locations.

2.14 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from structural-steel shapes, plates, and bars of profiles shown with continuously welded joints, and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work. Provide anchors, welded to trim, for embedding in concrete or masonry construction, spaced not more than 6 inches (150 mm) from each end, 6 inches (150 mm) from corners, and 24 inches (600 mm) o.c., unless otherwise indicated.

C. Surface Applied Corner Guards: Provide corner guards fabricated from angles of sizes shown, or if not shown, of minimum 4-1/2 inch by 4-1/2 inch by 1/4 inch thick equal leg angles. Drill and countersink legs of angles, for fastening to substrates indicated, with holes spaced 24 inches on center. Provide corner guard lengths of 42 inches, if not otherwise indicated.

D. Cast-In-Corner Guards: Provide corner guards fabricated from angles of size as shown, or if not shown, of minimum 4-1/2 inch by 4-1/2 inch by 1/4 inch thick equal leg angles. Fabricate each angle with welded-on stud anchors spaced 24 inches on center. Provide corner guard lengths of 42 inches, if not otherwise indicated.

E. Galvanize exterior miscellaneous steel trim; prime paint interior miscellaneous steel trim.

2.15 STRUCTURAL-STEEL DOOR FRAMES

A. Fabricate steel door frames from structural shapes and bars of size and to dimensions indicated, fully welded together, with 5/8 by 1-1/2 inch (16 by 38 mm) steel channel stops, unless otherwise indicated. Plug-weld built-up members and continuously weld exposed joints. Secure removable stops to frame with countersunk machine screws, uniformly spaced at not more than 10 inches (250 mm) o.c. Reinforce frames and drill and tap as necessary to accept finish hardware.

B. Provide steel strap anchors, 1/8 by 2 inches (3 by 50 mm), with a minimum 6 inch (150 mm) embedment and 2 inch (50 mm) hook, unless otherwise indicated, for securing door frames into adjoining concrete or masonry. Weld anchors to frame jambs no more than 12 inches (300 mm) from both bottom and head of frame, and space anchors not more than 30 inches (750 mm) apart.

C. Extend bottom of frames to floor elevation indicated with steel angle clips welded to frames for anchoring frame to floor with expansion shields and bolts.

D. Galvanize exterior frames; prime paint interior frames.

2.16 PIPE BOLLARDS

A. Fabricate pipe bollards from Schedule 40 steel pipe.

B. Fabricate bollards with 3/8 inch (10 mm) thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4 inch (19 mm) anchor bolts.

1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.

C. Fabricate sleeves for bollard anchorage from steel pipe with 1/4 inch (6 mm) thick steel plate welded to bottom of sleeve.

D. Galvanize bollards after fabrication.

2.17 METAL BAR GRATINGS

A. General: Produce metal bar gratings in accordance with the following:

1. For Gratings Exposed to Non-Vehicular Loads: NAAMM MBG 531 Metal Bar Grating Manual.
2. For Gratings Exposed to Vehicular Loads: NAAMM MBG 532 Heavy Duty Metal Bar Grating Manual.

B. Provide gratings including supplementary framing and supports to support specified loads. Provide gratings of welded type construction, rectangular pattern with plain surface bars in the same plane; accurately fabricated free from warps, twists or other defects affecting their serviceability or appearance. Fabricate gratings from ASTM A 36 structural steel bars.

C. Fabricate cutouts in grating sections for penetrations required. Arrange layout of cutouts to permit grating removal without disturbing items penetrating gratings.

1. Edge band openings in grating that interrupt 4 or more bearing bars with bars of same size and material as bearing bars.
2. Do not notch bearing bars at supports to maintain elevation.

D. Galvanize metal bar gratings after fabrication.

2.18 TRENCH DRAIN GRATINGS AND FRAMES

A. Heavy duty ductile iron trench drain gratings and frames, designed for vehicular loads. Provide units with integral anchors, bolts, machined joints.

B. Basis of Design: Neenah Foundry Co.; Series R-4990-width as indicated, or if not indicated, provide 14 inch wide grate, Type A grate opening with standard Type X support frame.

2.19 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

2.20 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:

1. ASTM A 123, for galvanizing steel and iron products.
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces by removing oil, grease, and similar contaminants in accordance with SSPC-SP 1 "Solvent Cleaning," followed with the SSPC surface-preparation specifications listed below and environmental exposure conditions of installed metal fabrications. Surface preparation shall be done after fabrication and immediately prior to shop painting. Apply shop coat of paint within 4 hours after cleaning and before rust bloom occurs.

1. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
2. Exteriors (SSPC Zone 1B): SSPC-SP 6, "Commercial Blast Cleaning."

C. Apply a minimum of one coat of shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be field welded, and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Dry Film Thickness of Primer: 2.5 to 3.0 mils, dry film thickness. Apply paint thoroughly and evenly to dry surfaces, free from holidays and pinholes, in accordance with manufacturer's directions.

2.21 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines or blend into finish.

B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

C. Bright, Directional Polish: No. 4 finish.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.22 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 607.1.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors. Drill holes for bolts to the exact diameter of the bolt. Provide screws threaded full length to the screw head.

B. 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.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

D. 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.

E. 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. Quality of Workmanship:

    a. At concealed connections: No improvement from mill finish, except preparation necessary for priming is required. Welds are not required to be ground.
    b. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness , pits, mill marks, nicks, or scratches shows after finishing and contour of welded surface matches that of adjacent surface. Defects and distortions shall not be visible to the eye nor show through painted or polished surfaces.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.2 SETTING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use non-shrink grout, either metallic or non-metallic, in concealed locations where not exposed to moisture; use non-shrink, non-metallic grout in exposed locations, unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.3 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings, if any.

B. Vertical Folding Operable Partition Horizontal Channel Framing: Anchor supports securely to and rigidly brace from building structure. Laser level horizontal framing.

C. Anchor supports for operable partitions securely to and rigidly brace from building structure.

3.4 INSTALLING PIPE BOLLARDS

A. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. After bollards have been inserted into sleeves, fill annular space between bollard and sleeve solidly with non-shrink, non-metallic grout, mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch (3 mm) toward bollard.

B. Anchor bollards in concrete in formed or core-drilled holes not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) greater than OD of bollard. After bollards have been inserted into holes, fill annular space surrounding bollard solidly with non-shrink, non-metallic grout, mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch (3 mm) toward bollard.

C. Anchor bollards in place with concrete footings. Support and brace bollards in position in footing excavations until concrete has been placed and cured.

D. Anchor bollards to existing construction with post-installed anchors and bolts. Provide four 3/4 inch (19 mm) anchors at each bollard, unless otherwise indicated. Embed anchors at least 4 inches (100 mm) in existing concrete.

E. Fill bollards solidly with concrete, mounding top surface.

3.5 INSTALLING METAL BAR GRATINGS

A. General: Install gratings to comply with recommendations of NAAMM grating standard referenced under Part 2 that apply to grating types indicated, including installation clearances and standard anchoring details.

B. Secure removable units to supporting members with type and size of clips and fasteners indicated, or if not indicated as recommended by grating manufacturer for type of installation conditions shown.

C. Secure non-removable units to supporting members by welding.

3.6 ADJUSTING AND CLEANING

A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 23 "Interior Painting" and Section 09 96 00 "High-Performance Coatings."

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 50 00

SECTION 05 70 00 - DECORATIVE METAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall panels.

    a. Arktura Graphic Perforated Aluminum Wall Panels.
    b. Arktura Vapor.

2. Decorative metal trim.

B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for non-decorative metal fabrications.

1.2 COORDINATION

A. Coordinate installation of anchorages for decorative metal items. 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.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, including finishing materials.

B. Shop Drawings: Show fabrication and installation details for decorative metal.

1. Include plans, elevations, component details, and attachments to other work.
2. Indicate materials and profiles of each decorative metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.

C. Samples for Verification: For each type of exposed finish required.

1. Sections of linear shapes.
2. Samples of welded joints showing quality of workmanship and color matching of materials.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified fabricator and finisher.

B. Welding certificates.

1.5 QUALITY ASSURANCE

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

B. Installer Qualifications: Fabricator of products.

C. Anodic Finisher Qualifications: A firm experienced in successfully applying anodic finishes of type indicated and employing competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.

D. Powder-Coating Applicator Qualifications: A firm experienced in successfully applying powder coatings of type indicated and employing competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.

E. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.3, "Structural Welding Code - Sheet Steel."
4. AWS D1.6, "Structural Welding Code - Stainless Steel."

F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

G. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store decorative metal in a well-ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

B. Deliver and store cast-metal products in wooden crates surrounded by sufficient packing material to ensure that products will not be cracked or otherwise damaged.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with decorative metal by field measurements before fabrication and indicate measurements on shop drawings.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. Provide materials without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

2.2 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.

B. Extruded Bars and Shapes: ASTM B 221 (ASTM B 221M), Alloy 6063-T5/T52.

C. Extruded Structural Round Tubing: ASTM B 429/B 429M, Alloy 6063-T6.

D. Drawn Seamless Tubing: ASTM B 210 (ASTM B 210M) or ASTM B 483/B 483M, Alloy 6063-T832.

E. Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 5005-H32smooth, high-quality finish and is a preferred choice for anodizing.

2.3 STAINLESS STEEL

A. Tubing: ASTM A 554, Grade MT 304.

B. Pipe: ASTM A 312/A 312M, Grade TP 304.

C. Sheet, Strip, Plate, and Flat Bar: ASTM A 666, Type 304.

D. Bars and Shapes: ASTM A 276, Type 304.

2.4 STEEL AND IRON

A. Tubing: ASTM A 500 (cold-formed).

B. Bars: Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.

C. Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

E. Steel Sheet, Cold Rolled: ASTM A 1008/A 1008M, either commercial steel or structural steel, exposed.

2.5 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:

1. Aluminum Items: Type 304 stainless-steel fasteners.
2. Stainless-Steel Items: Type 304 stainless-steel fasteners.
3. Uncoated-Steel Items: Plated steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed, Type 304 stainless-steel fasteners where exposed.
4. Class Fe/Zn 25 for electrodeposited zinc coating.
5. Dissimilar Metals: Type 304 stainless-steel fasteners.

B. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.

C. Provide concealed fasteners for interconnecting components and for attaching decorative metal items to other work unless otherwise indicated.

1. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

E. Post-Installed Anchors: Torque-controlled expansion type or chemical type.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 unless otherwise indicated.
2. Material for Locations Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.6 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For aluminum, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Shop Primers: Provide primers that comply with Section 09 91 23 "Interior Painting."

C. Intermediate Coats and Topcoats for Steel: Provide products that comply with Section 09 91 23 "Interior Painting."

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.7 FABRICATION, GENERAL

A. Assemble items in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

B. Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

D. Form simple and compound curves in bars, pipe, tubing, and extruded shapes by bending members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces.

E. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

F. Mill joints to a tight, hairline fit. Cope or miter corner joints. Fabricate connections that will be exposed to weather in a manner to exclude water.

G. Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work. Cut, reinforce, drill, and tap as needed to receive finish hardware, screws, and similar items unless otherwise indicated.

H. Comply with AWS for recommended practices in shop welding. Weld behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded joints of flux, and dress exposed and contact surfaces.

1. Where welding cannot be concealed behind finished surfaces, finish joints to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 Welds: no evidence of a welded joint.

2.8 WALL PANELS

A. Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal wall panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.9 DECORATIVE METAL TRIM

A. Fabricate from aluminum, stainless-steel or steel shapes, sheet or plate of thickness, size, and pattern indicated. Roll, press, and grind metal to flatten and to remove burrs and deformations. Miter corners and connect with concealed splice plates.

2.10 FINISHES, GENERAL

A. Decorative metal finishes are designated with Item Code MT# in the Finish Schedule and on the Drawings.

B. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.11 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.12 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.

C. Directional Satin Finish: No. 4.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.13 STEEL AND IRON FINISHES

A. Preparing Nongalvanized Items for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."

B. Primer Application: Apply shop primer to prepared surfaces of items unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated ferrous-metal surfaces with primers specified in Section 09 91 23 "Interior Painting" unless indicated.

C. Shop-Painted Finish: Comply with Section 09 91 23 "Interior Painting."

1. Color: As indicated in Finish Schedule by manufacturer's designations.

D. Powder-Coat Finish: Prepare, treat, and coat nongalvanized ferrous metal to comply with resin manufacturer's written instructions and as follows:

1. Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Treat prepared metal with iron-phosphate pretreatment, rinse, and seal surfaces.
3. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils (0.04 mm).
4. Color: As indicated in Finish Schedule by manufacturer's designations.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide anchorage devices and fasteners where needed to secure decorative metal to in-place construction.

B. Perform cutting, drilling, and fitting required to install decorative metal. Set products accurately in location, alignment, and elevation, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry, or similar construction.

C. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of decorative metal, restore finishes to eliminate evidence of such corrective work.

D. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

E. Install concealed gaskets, joint fillers, insulation, and flashings as work progresses.

F. Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at same location.

1. Retain protective coverings intact; remove coverings simultaneously from similarly finished items to preclude nonuniform oxidation and discoloration.

G. Field Welding: Comply with applicable AWS specification for procedures of manual shielded metal arc welding and requirements for welding and for finishing welded connections in "Fabrication, General" Article. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

H. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.2 INSTALLING WALL PANELS

A. Install paneling level, plumb, true, and straight with no distortions. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm). Install with no more than 1/16 inch in 96-inch (1.6 mm in 2400-mm) vertical cup or bow and 1/8 inch in 96-inch (3 mm in 2400-mm) horizontal variation from a true plane.

1. For flush paneling with revealed joints, install with variations in reveal width, alignment of top and bottom edges, and flushness between adjacent panels not exceeding 1/16 inch (1.5 mm).

B. Anchor paneling to supporting substrate with concealed panel-hanger clips. Do not use face fastening unless otherwise indicated.

3.3 INSTALLING DECORATIVE METAL TRIM

A. Assemble trim and complete fabrication at Project site to the extent that it was not completed in the shop.

B. Install trim level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

C. Scribe and cut trim to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

D. Anchor trim to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners. Use fine finishing screws for exposed fastening, countersunk and filled flush with trim using filler matching finish of items being installed.

E. Install with minimum number of joints possible, using full-length pieces (from maximum length of material available) to greatest extent possible. Do not use pieces less than 96 inches (2400 mm) long except where shorter single-length pieces are necessary.

3.4 CLEANING AND PROTECTION

A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.

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

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

C. Protect finishes of decorative metal from damage during construction period with temporary protective coverings approved by decorative metal fabricator. Remove protective covering at time of Substantial Completion.

D. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 05 70 00

SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes miscellaneous carpentry.

1.2 ACTION SUBMITTALS

A. Product Data: Submit product data for each type of process and factory-fabricated product indicated.

1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that materials comply with requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels; for lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: Comply with DOC PS 20 "American Softwood Lumber Standard" and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.
4. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal (38-mm actual) thickness or less, unless otherwise indicated.

B. Wood Panels:

1. Plywood: Comply with DOC PS 1 "Construction and Industrial Plywood" for plywood panels. Use exterior grade for panels in wet conditions.
2. Thickness: As needed to comply with requirements specified but not less than thickness indicated.

2.2 FIRE-RETARDANT-TREATED MATERIALS

A. General: Provide chemical fire retardant process tested and labeled by UL with flame spread and smoke developed ratings of 25 or less. Comply with performance requirements in AWPA U1, Use Category UCFA as a minimum for pressure treatment. Size wood before treatment so that minimum cutting will be required after treatment. Kiln dry lumber to a maximum 19 percent moisture content, kiln dry plywood to a maximum 15 percent moisture content, after treatment. Treat indicated items and the following:

1. Wood members required to be treated by Building Code having jurisdiction at the site and wood members specified as fire-retardant-treated.

B. Identify fire-retardant-treated wood with appropriate classification marking of UL.

2.3 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Wood Preservatives shall comply with VOC content as shown in Section 01 81 23 "CALgreen Requirements."

B. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the 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, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

C. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

2.4 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber for support or attachment of other construction, including blocking, nailers, and similar members.

B. For concealed boards, provide lumber with 19 percent maximum moisture content and the following species and grades:

1. Mixed southern pine, No. 2 grade; SPIB.
2. Western Woods; WCLIB or WWPA, No. 2 Grade.

2.5 PANEL PRODUCTS

A. Concealed Plywood for Countertop Underlayment:

1. APA Exterior sheathing, manufactured with no added urea-formaldehyde, in thickness as indicated but not less than 3/4 inch (19 mm).

    a. Roseburg Forest Products; Oregon Plywood 2 softwood plywood sheathing.
    b. Roy O. Martin Lumber Company, Limited Partnership (MARTCO), Plywood Division; exterior softwood plywood sheathing.
    c. Potlatch Forest Products Corporation, Forest Products Div., exterior softwood plywood sheathing.

B. Medium-Density Fiberboard (Moisture Resistant): A sustainable, moisture-resistant, medium density fiberboard (MDF) panel manufactured from minimum 92 percent preconsumer recycled wood fiber complying with ANSI A208.2, Grade 155, having a minimum 48 pcf (769 kg/m3) density except that minimum for screw holding capacity on face shall be 325 pounds (1445 N); an ASTM E 84 Class C flame spread rating, minimum 3/4 inch (19 mm) thick, edged and faced as specified, fabricated with binder containing no added urea formaldehyde.

1. Roseburg Forest Products; NAUF Medex.

C. Telephone, Data, Security, Mirror,and Electrical Equipment Backing Panels:

1. APA, Exposure 1, C-C Plugged, fire-retardant treated, manufactured with no added urea-formaldehyde, in thickness indicated or, if not indicated, not less than 15/32 inch (11.9 mm) thick.

D. Medium-Density Fiberboard (fire rated): A sustainable, fire rated, medium density fiberboard (MDF) panel manufactured from minimum 82 percent recycled wood fiber complying with ANSI A208.2, Grade 130, having a minimum 48 pcf (769 kg/m3) density except that minimum for screw holding capacity on face shall be 250 pounds (1112N); an ASTM E 84 Class A flame spread rating, minimum 3/4 inch (19 mm) thick, edged and faced as specified, fabricated with binder containing no added urea formaldehyde.

1. Roseburg Forest Products; NAUF Medite FR.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

B. Power-Driven Fasteners: NES NER-272.

C. Nails, Wire, Brads, and Staples: Select material, type, size, and finish required for each use.

1. ASTM F 1667 for driven fasteners such as nails, spikes and staples.

2. ASTM F 547 for nails used with wood and wood based products.

D. Wood Screws: Select material, type, size, and finish required for each use. Comply with ASME B18.6.1.

E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Securely attach carpentry work as indicated and according to applicable codes and recognized standards.

C. Use fasteners of appropriate type and length. Predrill members when necessary to avoid splitting wood.

3.2 WOOD BLOCKING AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

3.3 PANEL PRODUCT INSTALLATION

A. General: Comply with applicable recommendations contained in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial," and local utility requirements, if any, for plywood backing panels utilized as indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Countertop Underlayment: Bolt to miscellaneous steel framing.
2. Plywood Backing Panels: Secure to wall using proper fastening devices for substrates encountered spaced 12 inches (305 mm) on center maximum at perimeter 1/2 inch (12.7 mm) from corners and three rows of 3 fasteners each in the backerboard field. Countersink fasteners flush with plywood surface. Butt adjacent panels without lapping.

END OF SECTION 06 10 53

SECTION 06 40 23 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes interior architectural woodwork:

1. Plastic-laminate cabinets.
2. Plastic-laminate countertops.
3. Closet and utility shelving.
4. Interior standing and running trim.
5. Shop priming of interior woodwork to receive painted finish.
6. Shop finishing of interior woodwork to receive opaque finish.
7. Shop finishing of interior woodwork to receive transparent finish.

B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for concealed countertop supports.
2. Section 05 70 00 "Decorative Metal" for metal trim.
3. Section 06 10 53 "Miscellaneous Rough Carpentry" for concealed blocking for millwork items.
4. Section 12 36 16"Metal Countertops" for metal countertops applied to architectural cabinetry.

1.2 ACTION SUBMITTALS

A. Product Data: Submit product data for each material and product specified and incorporated into items of architectural woodwork during fabrication, finishing, and installation.

1. Cabinet hardware and accessories.
2. Finishing materials and processes.
3. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings: Submit shop drawings showing locations of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components. Elevations shall be drawn at a scale of not less than 1/2" = 1'-0" (1:25). Details shall be drawn at a scale of not less than 3" = 1'-0" (1:5).

1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
2. Show locations and sizes of cutouts and holes for plumbing, electrical, computer and telephone equipment and other items installed in architectural woodwork.

C. Samples: Submit samples of the following:

1. Three 12 inch (305 mm) by 12 inch (305 mm) sample sets containing a minimum of two or more samples of transparent finished wood-veneer and plastic laminate veneered panel products, fabricated from each core product, for each veneer specified and demonstrating the proposed full range of appearance characteristics to be expected in completed work. Include at least one face-veneer seam in each sample.
2. Lumber and panel products for transparent finish, for each species and cut, finished on one side and one edge. Furnish lumber in 12 inch (305 mm) lengths, furnish panel samples in 12 inch (305 mm) squares.
3. Lumber and panel products with shop-applied opaque finish, for each finish system and color, with exposed surface finished. Furnish lumber in 12 inch (305 mm) lengths, furnish panel samples in 12 inch (305 mm) squares.
4. Thermoset decorative-overlay surfaced panel products, for each type, color, pattern, and surface finish.
5. Cabinet Locks: Three samples of each type.
6. Metal Trim Shapes: Three samples of each type and finish, 12 inches (305 mm) long.
7. Submit samples of each type of door specified showing construction and finishes selected. Samples shall be 12 inch (305 mm) by 12 inch (305 mm) corner section.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Instructions: Submit maintenance instructions for all countertop materials. Where countertop materials are recommended to be protected with hot pads, provide manufacturers properly sized for the hot equipment designed to be placed thereon.

1.4 QUALITY ASSURANCE

A. Single-Source Manufacturing and Installation Responsibility: Engage a qualified Manufacturer - acceptable to the Architect - to assume undivided responsibility for woodwork specified in this Section, including fabrication, finishing, and installation. The manufacturer shall have a minimum of 15 years successful experience in the custom fabrication and installation of architectural woodwork comparable to that shown and specified, be a member of the AWI, maintain an organized quality control program, perform its own in-house veneer lay-up work, and who retains facilities with sufficient capacity and quality to produce the required architectural woodwork without causing delay to the Project.

B. Quality Standard: Fabricate and install all architectural woodwork in accordance with the applicable requirements of Architectural Woodwork Standards, 2nd edition, published jointly by AWI, AWMAC, and WI, unless more stringent requirements are specified or shown.

C. Fire Performance Characteristics: Provide materials identical to those tested for the following fire performance characteristics per ASTM test methods indicated by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify treated lumber with classification marking of inspecting and testing organization in the form of separable paper label or, where required by authorities having jurisdiction, of imprint on lumber surfaces that will be concealed from view after installation.

1. Surface Burning Characteristics for Concealed Blocking, Furring, and Door Subframing: Not exceeding a flame spread of 25, and smoke developed of 50 when tested per ASTM E 84 for 30 minutes.
2. The fire performance finish requirements for all exposed interior wall and ceiling woodwork (including the paneling but not limited to paneling) substrates in fully sprinklered spaces shall be as follows which has been taken from the IBC 2015, Table 803.9. Footnotes to Table 803.9 that are pertinent to the project are also made a part of this specification.

Use Group	Interior Exit Stairways, Exit Ramps, and Exit Passageways	Corridors and Enclosures for Exit Access Stairways, and Exit Access Ramps	Rooms and Enclosed Spaces
A-1, and A-2	Class B	Class B	Class C
A-3	Class B	Class B	Class C
B, E, M, R-1	Class B	Class C	Class C
S	Class C	Class C	Class C

3. Class B: Flame spread 26-75, smoke developed 0-450 when tested in accordance with ASTM E 84.
4. Class C: Flame spread 76-200, smoke developed 0-450 when tested in accordance with ASTM E 84.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration. Do not deliver woodwork until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in "Field Conditions" Article.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork 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 woodwork is indicated to fit to other construction, verify actual dimensions of other construction by accurate field measurements before fabrication of woodwork; and indicate measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed and indicate measurements on shop drawings.
2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

1.8 PREINSTALLATION COORDINATION MEETING

A. Meet at the Project site, prior to installation of architectural woodwork, to review the substrate preparation, installation and coordination with other trades, special details and conditions, and other topics related to the architectural woodwork. The preinstallation meeting shall include the Architect, the Contractor, architectural woodworker, and any subcontractors affected by the architectural woodwork installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that comply with requirements of the AWS quality standard for each type of woodwork and quality grade specified.

B. Composite Wood Products: Products shall be made without urea formaldehyde.

C. Lumber Standards: Comply with applicable provisions for grading and workmanship of AWS Architectural Woodwork Standards, Section 3, and the requirements shown and specified; where standards conflict the more stringent shall apply. Provide lumber surfaced 4 sides (S4S) and fabricated to profiles shown. All lumber shall be kiln dried to the moisture content indicated in AWS, Section 2.

1. Furring, Blocking, Shims: No. 1 Common; Southern Pine.
2. Door Subframes: No. 1 Common Southern Pine, fire retardant treated to reduce combustibility.
3. Solid Hardwood for Opaque Finish (WD##): Plain sawn Yellow Poplar, free from checks, splits, sound knots.
4. Solid Hardwood for Transparent Finish (WD##): Matching each of the Architect's veneer samples; refer to Finish Schedule on the Drawings for each specie.

D. Wood Veneers:

1. Species, Matching, and Cut for Transparent Finish: Complying with AWS, Section 4, and the following:

    a. (WD##) Specie and figuring as indicated on the Finish Schedule, book matched unless otherwise indicated, minimum 5 inch (127 mm) width leaves, complying with HPVA HP-1, Grade AA, matching Architect's sample.

E. Wood Panel Products:

1. Medium-Density Fiberboard (non-moisture resistant): A sustainable, medium density fiberboard (MDF) panel manufactured from minimum 92 percent preconsumer recycled wood fiber complying with ANSI A208.2, Grade 155, having a minimum 47 pcf (752 kg/m3) density except that minimum for screw holding capacity on face shall be 300 pounds (1333 N); an ASTM E 84 minimum Class C flame spread rating, minimum 3/4 inches (19 mm) thick, edged and faced as specified, fabricated with binder containing no added urea formaldehyde.

    a. Roseburg Forest Products; NAUF Medite II.

2. Medium-Density Fiberboard (moisture resistant): A sustainable, moisture-resistant, medium density fiberboard (MDF) panel manufactured from minimum 92 percent preconsumer recycled wood fiber complying with ANSI A208.2, Grade 155, having a minimum 48 pcf (769 kg/m3) density except that minimum for screw holding capacity on face shall be 325 pounds (1445 N); an ASTM E 84 Class C flame spread rating, minimum 3/4 inches (19 mm) thick, edged and faced as specified, fabricated with binder containing no added urea formaldehyde.

    a. Roseburg Forest Products; NAUF Medex.

3. Medium-Density Fiberboard (fire rated): A sustainable, fire rated, medium density fiberboard (MDF) panel manufactured from minimum 82 percent preconsumer recycled wood fiber complying with ANSI A208.2, Grade 130, having a minimum 48 pcf (769 kg/m3) density except that minimum for screw holding capacity on face shall be 250 pounds (1112 N); an ASTM E 84 Class A flame spread rating, minimum 3/4 inches (19 mm) thick, edged and faced as specified, fabricated with binder containing no added urea formaldehyde.

    a. Roseburg Forest Products;NAUF Medite FR.

4. Medium Density Particleboard: A medium density particleboard (MDP) panel manufactured from 100 percent post industrial recycled wood residuals complying with ANSI A208.1, Type M-3-with a minimum 45 pcf (721 kg/m3) density except that minimum for screw holding capacity on face shall be 247 pounds (1098 N), an ASTM E 84 minimum Class C flame spread rating; minimum 3/4 inches (19 mm) thick, edged and faced as specified and manufactured with binder containing no added urea-formaldehyde.
5. Hardboard: ANSI A135.4.
6. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde. Available Products:

a. Panel Source International, Inc.; PureKor Class A Pyroblock®FR Panel.

F. Thermoset Decorative Overlay (Melamine): Particleboard or medium-density fiberboard with surface of thermally fused, melamine-impregnated decorative paper complying with the recommendations of the Composite Panel Association's Technical Bulletin "Laminating Composite Panels."

1. Types: As indicated in the Finish Schedule on the Drawings.

G. High-Pressure Decorative Laminate (PL##): Complying with NEMA LD 3 for Horizontal General Purpose Grade (HGS) typically and Vertical General Purpose Grade (VGS) where specified. Nominal thickness for HGS and VGS laminates to be 0.048 inches (1.2 mm) +/-0.005 inches (0.12 mm) and 0.028 inches (0.71 mm) +/- 0.004 inches (0.10 mm), respectively. Where high pressure decorative laminate is indicated to be faced with aluminum, provide aluminum sheet goods specifically made for laminating to vertical MDF and particleboard substrates in sheet thickness of 0.025 inches (0.63 mm) +/- 0.002 inches (0.05 mm).

1. Types: As indicated in the Finish Schedule on the Drawings.

a. Provide factory applied protective peel coat to prevent surface damage during fabrication and handling of aluminum faced decorative laminates. Remove protective peel coat after installation in accordance with the manufacturer's recommendations. If the film is left in place after installation, exposure to direct sunlight for a prolonged period may cause a paste residue and create other problems.

2. Backing Sheets: Non-decorative, high pressure laminate, NEMA LD3, Grade, types and thickness to match face sheets and equalize pull.

H. Adhesives, General: Use only low emitting VOC adhesives that leave no glue lines on finished surfaces of architectural woodwork. Do not use adhesives that contain urea formaldehyde.

1. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. Wood Glues: 30 g/L.
b. Contact Adhesives: 80 g/L.

2.2 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where indicated, use materials impregnated with fire-retardant chemical formulations indicated by a pressure process or other means acceptable to authorities having jurisdiction to produce products with fire-test-response characteristics specified.

1. Do not use treated material that does not comply with requirements of referenced woodworking standard. Do not use twisted, warped, bowed, discolored, or otherwise damaged or defective lumber or panel products.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.
3. Treat only door subframing, blocking and furring items.

B. Fire-Retardant-Treated Lumber: Materials impregnated with fire-retardant chemical formulations to comply with AWPA U1, Use Category UCFA. Kiln-dry material after treatment to levels required for untreated woodwork.

C. Fire-Retardant Particleboard: Panels made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture and complying with fire-test-response characteristics specified.

D. Fire-Retardant Fiberboard: ANSI A208.2 medium-density fiberboard panels made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture and complying with fire-test-response characteristics specified.

2.3 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials for a complete installation of architectural woodwork, except for items specified in Section 08 71 00 "Door Hardware."

B. Hardware Standard: Comply with BHMA A156.9 for items indicated by referencing BHMA numbers or items referenced to this standard.

C. Frameless Concealed Hinges for Cabinet Doors (European Type): Concealed all-metal furniture hinges adaptable or engineered for 35 mm hinge cup boring pattern, with minimum 155 degree opening angle, three-dimensional hinge having adjustments located in the steel hinge arm, steel or die-cast zinc hinge cups, mounting plates, and plastic insertion dowels to receive hinge screws. Automatic soft closing shall engage only in the last 10 degrees of swing. All hinge pins and linkages shall be hardened. Complying with BHMA A156.9, B01602. Bright nickel finish (US15).

1. Hinge Quantity: Provide hinge quantity as recommended by hinge manufacturer based on cabinet door width, weight, thickness, door material, and hinge cup selection.
2. Metal Furniture Hinge Products and Manufacturers: One of the following:

    a. Basis of Design: Grass Tiomos Series; Grass America, Inc.; Kernersville, NC.
    b. Blumotion Series; Blum USA; Stanley, NC.
    c. Salice; Silencia Series 200.

D. Hidden Gate Hinges: Full mortised, invisible hinges and specifically manufactured for door thickness indicated and fabricated from high strength plated brass or steel, heavy duty zinc alloy or brass castings, and non-removable riveted hinge pins. Each hinge shall be engineered for smooth performance with laminated link construction supplemented by anti-friction materials that reduce friction for smooth, free hinge operation. Complying with BHMA A156.9, B01501.

1. Hinge Quantity: Provide hinge quantity as recommended by hinge manufacturer based on cabinet door width, weight, thickness, door material, and hinge cup selection.
2. Metal Furniture Hinge Products and Manufacturers: One of the following:

    a. Basis of Design: "Soss" Hinges; Universal Industrial Products Company, Pioneer, OH.
    b. Vici Hinges 341.25.xxx; Hafele America; Archdale, NC.
    c. Soss Hinge 341.07.xxx; Hafele America Co.; Archdale, NC.

E. Piano Hinges: Continuous type, satin finished stainless steel and complying with BHMA A156.9, B51491.

F. Edge Pulls: Full mortised, solid, bronze or brass door edge pull, with 1/2 inch (13 mm) finger clearance, 1/4 inch (6.4 mm) diameter roll diameter, having nominal overall roll length dimension of 3 inches (76 mm) long, with backbend drilled and countersunk to receive 2 screw fasteners; form for full mortise application; satin finished chrome (US26D); one of the following:

1. SRO Style Edge Pull; Tydix Products, Inc.
2. DP3A Tab Drawer Pull; Doug Mockett and Co., Inc.

G. Angled Pulls: Full mortised, solid, stainless steel angled pull, with nominal 3/4 inch (19 mm) finger clearance, having nominal overall length of 4-3/4 inches (120 mm) long, with backbend drilled and countersunk to receive 2 screw fasteners; form for full mortise application; satin finished stainless steel (US32D); provide the following:

1. DP157-SSS Angled Pull; Doug Mockett and Co., Inc.

H. Catches: Magnetic, complying with BHMA A156.9, B03141 for single doors and B03161 for double doors.

1. For Single Doors:One of the following:

    a. CD41 Single Magnetic Cabinet Catch; Stanley Commercial Hardware.
    b. 900; Rockwood Manufacturing Company, Rockwood, PA.
    c. 246.94.701 housing x 246.94.702 counterpiece; Hafele America Co. Archdale, NC.

2. For Double Doors: One of the following:

    a. 901; Rockwood Manufacturing Company.
    b. CD45 Double Magnetic Cabinet Catch; Stanley Commercial Hardware.

I. Cabinet Shelf Rests: Nickel plated brass or steel, or stainless steel, minimum 6 mm diameter shelf support pegs in sockets, complying with BHMA A156.9, B04013. One of the following:

1. Hafele 282.01.701 x 282.50.704; Hafele America, Co.
2. K-10S with K-2 Sleeve; Brusso, Inc.
3. 331 Series Flat Top Shelf Support Pin with 325 Series Insert Grommet; Knape and Vogt.

J. Closet Rods and Flanges: 1-1/2 inch (38 mm) diameter, satin finished chrome plated steel or satin finished stainless steel with matching end flanges.

K. Adjustable Shelf Standards and Brackets for Wall-Hung Open-Shelving:

1. Standards: Model No. 87 ANO Extra Heavy Duty 87-187 Series; widths and lengths as indicated, by Knape and Vogt.
2. Brackets: Model No. 186 LL ANO for 8- and 10-inch (200- to 250-mm) andModel No. 187 LL ANO for 12- to 24-inch (300- to 600-mm) deep shelves by Knape and Vogt.
3. Shelf Rests: Model No. 210 ANO End Rest and Model No. 211 ANO Center Rest with Model No. 129 RUB Rubber Cushions.

L. Drawer Slides:

1. Pencil Drawer Slides: Similar to Accuride 2006 having 3/4 extension carburized steel ball bearing, side mounting, 45 pound (20.25 kg) capacity medium duty load rating, cold rolled steel slide members and ball retainers, bright electro zinc plate finish.
2. Drawers less than 4 inches (102 mm) deep: Similar to Accuride 3832EC "Easy Close" having full extension carburized steel ball bearing, side mounting, 100 pound (45 kg) capacity medium duty load rating, cold rolled steel slide members and ball retainers, cushioned in and outstops, detent-in, progressive action, positive stop, bright electro zinc plate finish.
3. Drawers greater than 4 inches (102 mm) but less than 8 inches (203 mm) deep: Similar to Accuride 3832EC "Easy Close" having full extension carburized steel ball bearing, side mounting, 100 pound (45 kg) capacity medium duty load rating, cold rolled steel slide members and ball retainers, cushioned in and outstops, detent-in, progressive action, positive stop, bright electro zinc plate finish.
4. Drawers greater than 8 inches (203 mm) deep: Similar to Accuride 3634EC "Easy Close" having full extension carburized steel ball bearing, rail mounting, 150 pound (67.5 kg) capacity heavy duty load rating, cold rolled steel slide members and ball retainers, cushioned in and outstops, detent-in, progressive action, positive stop, bright electro zinc plate finish.
5. Refuse Cabinets: Similar to Accuride 3600-201 having full extension carburized steel ball bearing, bottom mounting, 175 pound (78.75 kg) capacity heavy duty load rating, cold rolled steel slide members and ball retainers, cushioned in and outstops, progressive action, positive stop, bright electro zinc plate finish.
6. Accuride International, S.A. de C.V., Mexicali, B.C., C.P. 21395 Méexico.

M. Flipper Door Slides: For vertically mounted retracting cabinet doors up to 75 pounds (34 kg) and 72 inches (1800 mm) tall, Model No. 1432, black color, with hinge carrier strip by Accuride, Inc.

N. Silencers: Provide rubber silencers on jamb and/or head and sill strike areas of all cabinet doors and drawers, 2 for paired doors, and 3 for single doors. Silencers shall be approximately 1/4-inch (6.4-mm) diameter, color compatible with adjacent finish.

O. Door and Drawer Locks: All cabinet doors and drawers shall be furnished with locks. Finish exposed portions of locks to match cabinet pull finish. Furnish 2 keys with each lock and key all locks inside one room alike and provide masterkey for all locks in Project.

1. Drawers: Provide one of the following lock assemblies:

    a. Cam lock similar to Hafele 235.10.261, 1-3/16 inch cylinder length, chrome plated, with straight and offset cams; Hafele America, Co., Archdale, NC.
    b. Cam lock similar to CompX Type 170 Thick Panel Lock x LP-700 lock plug, satin nickel finish, with surface-mounted strike plate SP-100; CompX Timberline, Neenah, WI.

2. Single Doors: Provide one of the following lock assemblies:

    a. Latch lock similar to Olympus 998/999 Series x 999-Strike, chrome plated, sized to fit opening; Olympus Lock, Inc., Lynnwood, WA.
    b. Deadbolt similar to CompX CB-281 cylinder body x LP-700 lock plug, satin nickel finish, with surface-mounted strike plate SP-100; CompX Timberline, Neenah, WI.

3. Pairs of Doors: Provide the following:

    a. At inactive leaf, Furniture bolt similar to Hafele 252.02.644, polished chrome, with strike 251.60.703; Hafele America, Co.
    b. At active leaf, provide Single Door lock assembly.

P. Grommets for Cable Passage through Countertops: 2-1/2-inch (64-mm) OD, black, metal grommets and matching metal caps with slot for wire passage.

1. Product: Subject to compliance with requirements, provide " MM Solid Metal series" by Doug Mockett and Co., Inc.

Q. Exposed Hardware Finishes: Unless otherwise specified above, or on the Drawings, all exposed portions of the woodwork hardware shall comply with BHMA A156.18 for BHMA finish number indicated.

1. Dark, Oxidized, Satin Bronze, Oil Rubbed: BHMA 613 for bronze base; BHMA 640 for steel base.
2. Bright Brass, Clear Coated: BHMA 605 for brass base; BHMA 632 for steel base.
3. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
4. Bright Chromium Plated: BHMA 625 for brass or bronze base; BHMA 651 for steel base.
5. Satin Stainless Steel: BHMA 630.
6. Bright Stainless Steel: BHMA 629.

R. Stainless Steel Trim: Custom fabricate stainless steel trim shapes to the sizes, shapes and profiles shown from the following materials. Provide in standard commercial tempers and hardness, as required for fabrication, strength and durability from Type 304 alloy. Form exposed work true to line and level, with flush surfaces and accurate angles. Ease exposed edges to a radius of approximately 1/32 inch (0.79 mm) radius, unless otherwise shown. Miter exposed corner joints and machine fit to a hairline joint. All sheet goods shall be provided finished one side only. Finish designation shown on the Drawings are NAAMM nomenclature.

1. Sheet and Plate: ASTM A 666.
2. Bar Stock: ASTM A 276.
3. Pipe: ASTM A 312, Grade TP 304.
4. Tubing: ASTM A 554, Grade MT 304.

S. Stainless Steel Trim Finish: Provide the following mechanical finish to the exposed surfaces of the fabricated work to the extent indicated (NAAMM nomenclature), with texture and reflectivity as required to match the Architect's sample.

1. No. 4 (bright directional polish).

T. Steel Reinforcing: Carbon steel shapes, tubes and plates complying with ASTM A 36 (shapes and plates), and ASTM A 500 or A 501 (for tubes).

1. Shop Primer for Concealed Steel Reinforcing: Provide fast curing, lead and chromate free, universal modified alkyd primer complying with performance requirements in FS TT-P-664.
2. Electrodes for Concealed Steel Reinforcing: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded.

U. Resilient Base: Refer to Section 09 65 13 "Resilient Wall Base and Accessories."

V. Light Fixtures: Approximately 1-1/4 inch (32 mm) high surface mounted continuous undercabinet LED task light, with adjustable rotation of plus or minus 30 degrees. Task lighting shall have end butted, fixture to fixture, ganging with concealed wiring. Provide each ganged section of light fixtures with a single dimmer switch that, when activated, will switch the entire ganged section of light fixtures to either "on" or "off," and also offers dimming from full capacity to 5 percent capacity.

1. Basis-of-Design Manufacturer and Fixture: Workrite Ergonomics Inc.; Verano Series undercabinet lighting, (800) 959-9675. Other manufacturers will be considered subject to Architect's acceptance.
2. All light fixture components shall be UL Approved and Listed for the applications indicated. Housings shall be constructed of recycled aluminum with water based enamel finish; with transformer to connect to 120 VAC electrical voltage. Provide NEC acceptable wiring, and conduits if required, from light fixtures complete with 3 prong connector for plugging into outlet strips or power receptacles.

3. Lamp Type and Wattage: Each fixture shall include evenly spaced 1W LED lamps with a color temperature of 3500 degrees Kelvin and a CRI of 92; length as required to suit applications shown; other manufacturers will be considered subject to Architect's acceptance.

W. Door Hardware: At full sized doors, provide door hardware as scheduled under Section 08 71 00 "Door Hardware."

X. Hanging (Zee Clip) Strips: Extruded aluminum zee type interlocking clips; type, size and quantity for the condition of use.

Y. Brushed Aluminum Trim Shapes: Custom fabricate aluminum trim shapes to the sizes, shapes and profiles shown from the following materials. Provide in standard commercial tempers and hardness, as required for fabrication, strength and durability. Form exposed work true to line and level, with flush surfaces and accurate angles. Miter exposed corner joints and machine fit to a hairline joint. Finish designations are NAAMM nomenclature.

1. Plate: Alloy 5005 and ASTM B 209 (ASTM B 209M).
2. Bar Stock: ASTM B 211 (ASTM B 211M).
3. Extrusions: Alloy 6063 and ASTM B 221 (ASTM B 221M).
4. Aluminum Trim Finishes: Provide the following finishes to the exposed surfaces of the fabricated work to the extent indicated (NAAMM nomenclature), with texture and reflectivity as required to match the Architect's sample.

    a. Class II, Clear Anodic Finish: Complying with AA-M10M32A31 for an Architectural Class II, medium satin, clear natural anodized finish.

Z. Screws: Select material, type, size, and finish required for each use. Comply with ASME B18.6.1.

AA. Nails, Wire, Brads, and Staples: Select material, type, size, and finish required for each use.

1. ASTM F 1667 for driven fasteners such as nails, spikes and staples.
2. ASTM F 547 for nails used with wood and wood based products.

BB. Anchors: Select material, type, size, and finish required by each substrate for secure anchorage. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors.

CC. Blind Splines: Specialty devices, as required for tight butt joining, types and size as recommended by woodwork fabricator.

DD. Covercaps: Where mortises of fastener heads, or draw downs are exposed (blind holes) in finished work, provide black plastic covercaps.

2.4 FABRICATION, GENERAL

A. General: Complete fabrication, including assembly, finishing, and hardware application, before shipment to Project site to the maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting. The width of scribe and filler panels shall not exceed 1/2 inch (13 mm), or 1/2 inch (13 mm) clear dimension from adjacent wall to outside face of cabinet door in a 90 degree position, whichever is greater.

1. Interior Woodwork Grades:

    a. Premium Grade at transparent-finished woodwork and opaque-finished woodwork
    b. Custom Grade at plastic laminate-finished woodwork and woodwork primed for field painting

B. Fabricate woodwork to dimensions, profiles, and details indicated.

1. Reinforcing shown is minimum. Provide additional steel and lumber reinforcing as required to sustain imposed loads and to ensure a rigid assembly.
2. Exposed surfaces shall be free from dents, tool marks, warpage, buckle, glue and open joints, or other defects affecting serviceability or appearance. Accurately fit all joints, corners and miters. Conceal all fasteners. Make threaded connections up tight so that threads are entirely concealed.

C. Shop cut openings to maximum extent possible, to receive hardware, 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.

1. Seal edges of openings in countertops with a coat of varnish.

2.5 WOOD CABINETS FOR PLASTIC LAMINATE FINISH

A. AWS Type of Cabinet Construction: Flush overlay.

B. Laminate Cladding for Exposed Surfaces: High-pressure decorative of grade indicated.

1. Horizontal Surfaces Other Than Tops: HGS.
2. Postformed Surfaces: HGP.
3. Edges: HGS unless otherwise indicated.
4. Colors, Patterns, and Finishes: As indicated on the Drawings and in the Finish Schedule.

C. Materials for Semiexposed Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.

1. Drawer Sides and Backs: Solid-hardwood lumber.
2. Drawer Bottoms: Hardwood plywood.

D. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

E. Cabinet Locks: Provide door and drawer locks.

2.6 PLASTIC LAMINATE COUNTERTOPS

A. General: Comply with AWS Section 11 and as follows.

B. High-Pressure Decorative Laminate Grade: HGS.

C. Colors, Patterns, and Finishes: As indicated on the Drawings and in the Finish Schedule.

D. Edge Treatment: Same as laminate cladding on horizontal surfaces unless otherwise indicated.

E. Core Material at Sinks: Particleboard or exterior-grade plywood.

2.7 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE AND TRANSPARENT FINISHES

A. General: Complying with AWS Sections 3 and 6, fabricated from solid hardwood with scarfed joints, profiles as indicated, finishes as indicated.

B. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.

C. Wood Species: Poplar for opaque finishes; solid hardwood plank finished with transparent finished wood veneer in veneer cut as indicated on the Drawings to match adjacent transparent finished veneered items.

2.8 CLOSET AND UTILITY SHELVING

A. General: Comply with AWS Section 10 and as follows.

B. Shelf Material: Medium density fiberboard where indicated to be painted; medium density particle board where indicated for plastic laminate or melamine veneer.

C. Cleats: 3/4-inch (19-mm) solid lumber or thermoset decorative panel.

D. Finishes: As shown and scheduled on the Drawings.

2.9 FLUSH WOOD DOORS FOR OPAQUE FINISH

A. Construction complying with AWI Woodwork Quality Standards: PC-5 CE particleboard core doors with minimum 1/16 inch (1.6 mm) thick, properly dried low density hardwood or high density hardboard crossbanding and medium density overlay (MDO) or high density fiberboard (HDF) face veneers.

1. Vertical Edges: Same as veneer, sanded eased edges, without visible joints in lock or hinge edges and free of knife and saw marks.
2. Core: Single thickness slab of particleboard complying with ANSI A208.1, 1-LD-2, hot pressed with synthetic resin glue.
3. Bonding: Stiles and rails bonded to core, then entire unit abrasive planed before veneering. Glue lines between the stiles and rails shall be minimum Type II complying with the performance requirements of WDMA TM-6.
4. Crossbanding materials shall extend full width of door with grain running horizontally, tapeless spliced without voids or show through (telegraphing), and directly glued to core and blocking. Sand crossbanding before application of face veneer. Face veneer shall extend full height of door with grain running vertically, and directly glued to crossband. Glue lines between the face veneer, crossbanding and blocking shall be of a type to comply with specified warranty using the hot plate process.

B. Prefitting: Fit wood doors to suit frame opening sizes indicated. Comply with the following:

1. Jamb and Head Clearance: 1/8 inch (3 mm).
2. Paired Door Openings Meeting Edge: 3/16 inch (4.8 mm) less than nominal door size for each leaf.
3. Sill Clearance: 1/4 inch (6.4 mm) from finished floor.

C. Machining: Machine wood doors, paneling and frames, for hardware. Comply with final hardware schedules, shop drawings, and hardware templates.

1. Hardware Location: +/- 1/32 inch (0.8 mm).
2. Pulls and Pivots: + 1/32 inch (0.8 mm), - 0 inches (0 mm).

D. Door Thickness: 1-3/4 inch (45 mm).

2.10 SHOP FINISHING

A. Production finish architectural woodwork at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.

B. Priming of interior architectural woodwork with field applied opaque finish required to be performed at fabrication shop are specified in this Section. Refer to Section 09 91 23 "Interior Painting" for finishing opaque finished architectural woodwork.

C. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative overlay.
2. Gluing of face veneers shall, where possible, be by the hot plate method; glued surfaces shall be in close contact throughout. Glue stains will not be permitted.
3. Grain of all transparent finished wood shall run in the direction shown, or if not shown, as accepted on the shop drawings.

D. Exposed Surfaces:

1. Transparent Finish (TF##):

a. Grade: Premium.
b. AWS System 5: Conversion Varnish for close grain woods.
c. Staining: Natural to match Architect's sample.
d. Sheen: Match Architect's samples.

2. Opaque Finish (OF##):

a. Grade: Custom.
b. AWS System 5: Conversion Varnish.
c. Color and Sheen: Match Architect's paint samples.

3. Plastic Laminate Finish: Gluing of plastic laminate surfacing materials shall be by the hot plate method, glued surfaces shall be in close contact throughout. Glue stains shall not be permitted.

E. Unexposed Wood Finish: Shop-applied alkyd type primer-sealer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Condition woodwork to average prevailing humidity conditions in installation areas.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming before installation.

3.2 INSTALLATION

A. Quality Standard: Install woodwork to comply with requirements of the AWS for the same grade specified in this Section for type of woodwork involved.

1. Install woodwork level, plumb, true, with no distortions, and with no variations in flushness of adjoining surfaces. Shim as required with concealed shims.
2. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.

B. Anchor woodwork to blocking built in or directly attached to substrates. Secure to blocking with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

C. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 96 inches (2438 mm) long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.

1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base, if finished.

D. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets without sag, bow, or other variation from a straight line.
2. Maintain veneer sequence matching of cabinets with transparent finish.
3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches (400 mm) on center with No. 10 wafer-head screws sized for 1-inch (25-mm) penetration into wood blocking, or hanging strips or with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

E. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Calk space between backsplash and wall with silicone sanitary sealant specified in Section 07 92 00 "Joint Sealants."
2. Secure backsplashes to tops with concealed metal brackets at 16 inches (406 mm) on center and to walls with adhesive.

F. Doors:

1. Coordinate installation with the work of other trades to ensure exact fit and perfect alignment. Verify dimensions before proceeding and obtain measurements at job site for work required to be accurately fitted to other construction.

2. Do not install wood doors until interior wet work, such as tile, terrazzo, and wallboard work are complete and dried in the areas to receive the wood doors.
3. Do not subject wood doors to abnormal humidity, dryness or heat. Do not expose doors to sudden changes in temperature such as forced heat.
4. Hang wood doors within frames. Align in frames for uniform clearance at each edge matching clearances specified for factory prefitting.
5. Field cutting, fitting or trimming, if required, shall be executed in a workmanlike manner. Cuts made at the job site shall be sealed immediately after cutting, using a clear varnish or sealer. Restore finish before installation, if fitting or machining is required at the job site for factory finished doors.
6. Hardware Installation: Install hardware in accordance with the instructions of the door hardware manufacturer; refer to Section 08 71 00 "Door Hardware."

G. Complete the finishing work specified in this Section to extent not completed at shop or before installation of woodwork.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean woodwork on exposed and semiexposed surfaces. Touchup shop-applied finishes to restore damaged or soiled areas.

1. Anodized aluminum surfaces shall be cleaned with warm water and mild soaps such as those used for hands or dishes. Do NOT use cleaners that contain abrasives, acids or alkalis, as they will mar the surface. Do NOT clean metal face with solvents, paint thinner or adhesive remover. After washing, always wipe the surface completely dry with a soft, clean cloth. Stubborn stains may be removed with a thin, clean oil and dry cloth.

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer, that ensures that woodwork will be without damage or deterioration at time of Substantial Completion.

END OF SECTION 06 40 23

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Formed wall flashing and trim.
2. Formed equipment support flashing.
3. Formed overhead-piping safety pans.

1.2 ACTION SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: Show layouts, profiles, shapes, seams, dimensions, and details for fastening, joining, supporting, and anchoring sheet metal flashing and trim.

C. Samples: For each exposed finish and for joint sealants.

1.3 INFORMATIONAL SUBMITTALS

A. Sealant Compatibility and Adhesion Test Reports: From sealant manufacturer for each combination of joint substrate, primer, backing, and sealant.

B. Product Certificates: For each type of coping and roof edge flashing that is SPRI ES-1 tested.

1.4 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.

1. For copings and roof edge flashings that are SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.

B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

C. Sealant Compatibility and Adhesion Testing: Use sealant manufacturer's standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

D. Pre-Installation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. SPRI Wind Design Standard: Manufacture and install copings tested according to SPRI ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawings.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.3 SHEET METALS

A. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003, 3004, 3105, or 5005, Temper suitable for forming and structural performance required, but not less than H14, finished as follows:

1. Mill Finish: Standard one-side bright.

B. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, No. 4 finish.

C. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality, mill phosphatized for field painting.

D. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); structural quality with manufacturer's standard clear acrylic coating both sides.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.

B. Felt Underlayment: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

1. Slip Sheet: Rosin-sized paper, minimum 3 lbs./100 sq. ft. (0.16 kg/sq. m).

C. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

1. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.
2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.
3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

D. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

E. Elastomeric Sealant: ASTM C 920 and Section 07 92 00 "Joint Sealants," elastomeric polyurethane or silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C 1311, 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.

H. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15 mil (0.4 mm) dry film thickness per coat.

2.5 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.

B. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

1. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

C. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.

D. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.

E. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal, and in thickness not less than that of metal being secured.

2.6 WALL SHEET METAL FABRICATIONS

A. Openings Flashing in Frame Construction: Fabricate through wall head, sill, jamb,base course/foundation, and similar flashings to extend 4 inches (100 mm) beyond wall openings. Form head and sill flashing with 2-inch- (50-mm-) high end dams. Fabricate from the following material:

1. Aluminum: 0.0320 inch (0.8 mm) thick.
2. Stainless Steel: 0.0156 inch (0.4 mm) thick.
3. Galvanized Steel: 0.0217 inch (0.55 mm) thick.
4. Aluminum-Zinc Alloy-Coated Steel: 0.0217 inch (0.55 mm) thick.

2.7 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following material:

1. Stainless Steel: 0.0187 inch (0.5 mm) thick.
2. Galvanized Steel: 0.0276 inch (0.7 mm) thick.
3. Aluminum-Zinc Alloy-Coated Steel: 0.0276 inch (0.7 mm) thick.

B. Overhead-Piping Safety Pans: Fabricate from the following material:

1. Stainless Steel: 0.0250 inch (0.65 mm) thick.
2. Galvanized Steel: 0.0396 inch (1.0 mm) thick.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.

1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

B. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Torch cutting of sheet metal flashing and trim is not permitted.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.

D. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

E. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and butyl sealant.

F. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

1. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.

G. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.

H. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.

1. Galvanized or Prepainted, Metallic-Coated Steel: Use stainless-steel fasteners.
2. Aluminum: Use aluminum or stainless-steel fasteners.
3. Stainless Steel: Use stainless-steel fasteners.

I. Seal joints with butyl sealant as required for watertight construction. Comply with recommendations of ASTM C 1193 and Section 07 92 00 "Joint Sealants."

J. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm) except where pretinned surface would show in finished Work.

1. Do not solder aluminum sheet.

3.2 ROOF FLASHING INSTALLATION

A. General: Install sheet metal roof flashing and trim to comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49.

1. Interlock bottom edge of roof edge flashing with continuous cleats anchored to substrate at 24 inch (600 mm) centers.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49.

1. Interlock exterior bottom edge of coping with continuous cleats anchored to substrate at 16 inch (400 mm) centers.
2. Anchor interior leg of coping with screw fasteners and washers at 18 inch (450 mm) centers.

D. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints a minimum of 4 inches (100 mm) in direction of water flow.

E. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.

F. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Secure in a waterproof manner. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with butyl sealant.

G. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:

1. Turn lead flashing down inside vent piping, being careful not to block vent piping with flashing.
2. Seal with butyl sealant and clamp flashing to pipes penetrating roof except for lead flashing on vent piping.

3.3 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Openings Flashing in Frame Construction: Install continuous through wall head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings.

C. Overhead-Piping Safety Pans: Suspend pans from pipe and install drain line to plumbing waste or drain line.

D. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with [**elastomeric**] [**butyl**] sealant to equipment support member.

E. Clean exposed metal surfaces for uniform oxidation and weather exposure; neutralize flux materials; clean off excess solder and sealants; and remove strippable films, if any.

END OF SECTION 07 62 00

SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes through-penetration firestop systems for penetrations through the following fire-resistance-rated assemblies, including both empty openings and openings containing penetrating items:

1. Roofs.
2. Walls and partitions.
3. Smoke barriers.

1.2 ACTION SUBMITTALS

A. Product Data: Submit product data for each type of through penetration firestop system product indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Through-Penetration Firestopping Schedule: Submit, for information only, a Through-Penetration Firestopping Schedule indicating the type of through-penetration firestop system to be installed for each penetration. Indicate each kind of construction condition penetrated and kind of penetrating item. Include firestop design designation of testing and inspection agency acceptable to the authorities having jurisdiction that evidences compliance with requirements for each condition indicated, and listed in the "Through Penetration Firestopping Schedule" at the end of Part 3 of this Section.

1. Submit documentation, including illustrations, from Underwriters Laboratories applicable to each through-penetration firestop.
2. Where Project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer.

B. Product Certificates: Signed by manufacturers of through-penetration firestop system products certifying that products furnished comply with requirements.

C. At Project Closeout, submit a Record Schedule, signed by the Installer, of systems installed, the UL design designations, and the location of each system. The submittal must have the Installer's signature.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified or licensed, by firestop system manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements. A manufacturer's willingness to sell its firestop system materials to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.

B. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in "Performance Requirements" Article:

1. Firestop tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, ITS, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
2. Through-penetration firestop systems identical to those tested per ASTM E 814. Provide rated systems complying with the following requirements.

    a. Through-penetration firestop systems corresponding to those indicated by reference to through-penetration firestop system designations listed by the following:

        1) UL in "Fire Resistance Directory."
        2) ITS in "Directory of Listed Products."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multi-component materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing and provide through-penetration firestop systems to accommodate sizes of sleeves, openings, core-drilled holes, or cut openings.

C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until Architect, Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: For the following constructions, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly penetrated.

1. Fire-resistance-rated non-load-bearing walls, including partitions, with fire-protection-rated openings.
2. Fire-resistance-rated roof assemblies.

B. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, as determined per ASTM E 814 or UL 1479, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.

C. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per ASTM E 814 or UL 1479, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:

1. Floor penetrations located outside wall cavities.
2. Floor penetrations located outside fire-resistive shaft enclosures.
3. Penetrations located in construction containing fire-protection-rated openings.
4. Penetrating items larger than 4 inch (100 mm) diameter nominal pipe or 16 square inch (10,323 square mm) in overall cross-sectional area.
5. Provide T-rating not less than the required rating of the element penetrated, but not less than 1 hour, minimum.

D. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
2. For floor penetrations with annular spaces exceeding 4 inches (100 mm) in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved either by installing floor plates or by other means.

E. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide through-penetration firestop systems that are UL listed for the penetrations listed in UL-Classified Through Penetration Fire Stopping Assemblies in the Schedule at the end of Part 3 of this Section.

2.3 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. VOC Content: Provide penetration firestopping that complies with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.
4. Plastic Foam Adhesives: 50 g/L.
5. Adhesives for Porous Materials (Except Wood): 50 g/L.
6. Fiberglass Adhesives: 80g/L.
7. Primers, Sealers and Undercoaters: 200 g/L.

C. Accessories: Provide components for each through-penetration firestop system needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including the following:

a. Slag-/rock-wool-fiber insulation.

b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
c. Fire-rated form board.
d. Fillers for sealants.

2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

D. Gypsum Products: The use of gypsum products for through-penetration firestopping is strictly prohibited.

E. Acoustical Performance: Provide non-hardening resilient firestop material at penetrations, sleeves and passthroughs in acoustic construction assemblies.

1. Acceptable Products:

a. Specified Technologies, Inc. Elastomeric Sealant ES100
b. Johns Manville Firetemp CI Caulk.
c. 3M Fire Barrier 2001 Silicone RTV Foam.
d. Hilti Flexible Firestop Sealant CP 606.

2.4 FILL MATERIALS

A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 by reference to the types of materials described in this Article. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.

B. Fire Rated Cable Management Devices: Factory-assembled round metallic sleeve device for use with cable penetrations, containing an integrated smoke seal fabric membrane that can be opened and closed for re-penetration.

C. Blocks/Plugs: Intumescent flexible block/plug suitable for reuse in re-penetration of openings. Blocks shall allow up to 12 inches (305 mm) of unreinforced annular space.

D. Drop-In Firestop Devices: Factory-assembled devices for use with combustible or noncombustible penetrants in cored holes within concrete floors. Device shall consist of galvanized steel sleeve lined with an intumescent strip, an extended rectangular flange attached to one end of the sleeve for fastening to concrete floor, and neoprene gasket.

E. Tub Box Kit: Cast-in place pre-formed plastic tub box kit with three support legs for use with drain piping assembly associated with bathtub installations.

F. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

G. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

H. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

I. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.

J. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

K. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

L. 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.

M. 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.

N. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

O. Silicone Sealants: Moisture-curing, 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 and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.

2.5 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer and the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without damaging substrate or disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing 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 indicated.

1. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
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 Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner may engage a qualified independent inspecting agency to inspect through-penetration firestop systems and to prepare test reports.

1. Inspecting agency will state in each report whether inspected through-penetration firestop systems comply with or deviate from requirements.

B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued.

C. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

3.5 IDENTIFICATION

A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:

1. The words: "Warning--Through-Penetration Firestop System--Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Through-penetration firestop system designation of applicable testing and inspecting agency.
4. Date of installation.
5. Through-penetration firestop system manufacturer's name.
6. Installer's name.

B. Identify fire-resistance-rated construction (including walls, shaft enclosures, partitions, and smoke barriers) with signs or stenciling permanently installed above suspended ceilings or in other concealed spaces. The lettering shall be 3 inches (75 mm) in height and spaced 12 feet (3658 mm) on center:

1. The words ____-HOUR FIRE AND SMOKE WALL - PROTECT ALL PENETRATIONS."

a. Replace blank with actual fire-resistance rating.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop 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 through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

C. THROUGH-PENETRATION FIRESTOP SYSTEM SCHEDULE

1. Select UL-classified systems from the attached schedule and submit "Through-Penetration Firestopping Schedule" as specified in Article 1.3, Submittals.

END OF SECTION 07 84 13

PENETRATION FIRESTOPPING SCHEDULE
FIRESTOPPING SYSTEMS ARE LISTED USING THE ALPHA-ALPHA-NUMERIC IDENTIFICATION SYSTEM PUBLISHED IN UL'S FIRE RESISTANCE DIRECTORY, VOLS. 2A - 2B

TYPE OF PENETRANT	CONSTRUCTION							
	FLOOR PENETRATION SYSTEMS (FIRST ALPHA COMPONENT = C OR F)				WALL PENETRATION SYSTEMS (FIRST ALPHA COMPONENT = C OR W)			
	CONCRETE FLOORS WITH A MINIMUM THICKNESS LESS THAN OR EQUAL TO 5 INCHES (127 MM)	CONCRETE FLOORS WITH A MINIMUM THICKNESS OF MORE THAN 5 INCHES (127 MM)	FRAMED FLOORS	FLOOR-CEILING ASSEMBLIES CONSISTING OF CONCRETE WITH MEMBRANE PROTECTION	CONCRETE OR MASONRY WALLS WITH A MINIMUM THICKNESS LESS THAN OR EQUAL TO 8 INCHES (203 MM)	CONCRETE OR MASONRY WALLS WITH A MINIMUM THICKNESS OF MORE THAN 8 INCHES (203 MM)	FRAMED WALLS	COMPOSITE PANEL WALLS
NO PENETRATING ITEMS	C-AJ-0001-0999 or F-A-0001-0999	C-BJ-0001-0999 or F-B-0001-0999	F-C-1001-1999		C-AJ-0001-0999, C-BJ-0001-0999, or W-J-0001-0999		W-L-000-1-0999	
METALLIC PIPE, CONDUIT, OR TUBING	C-AJ-1001-1999 or F-A-1001-1999	C-BJ-1001-1999, C-BK-1001-1999, or F-B-1001-1999	F-C-1001-1999	F-E-1001-1999	C-AJ-1001-1999, C-BJ-1001-1999, or W-J-1001-1999	C-BK-1001-1999 or W-K-1001-1999	W-L-1001-1999	W-N-1001-1999
NONMETALLIC PIPE, CONDUIT, OR TUBING	C-AJ-2001-2999 or F-A-2001-2999	C-BJ-2001-2999, C-BK-2001-2999, or F-B-2001-2999	F-C-2001-2999	F-E-2001-2999	C-AJ-2001-2999, C-BJ-2001-2999, or W-J-2001-2999	C-BK-2001-2999 or W-K-2001-2999	W-L-2001-2999	W-N-2001-2999
ELECTRICAL CABLES	C-AJ-3001-3999 or F-A-3001-3999	C-BJ-3001-3999, C-BK-3001-3999, or F-B-3001-3999	F-C-3001-3999	F-E-3001-3999	C-AJ-3001-3999, C-BJ-3001-3999, or W-J-3001-3999	C-BK-3001-3999 or WK-3001-3999	W-L-3001-3999	
CABLE TRAYS WITH ELECTRICAL CABLES	C-AJ-4001-4999 or F-A-4001-4999	C-BJ-4001-4999 or F-B-4001-4999			C-AJ-4001-4999, C-BJ-4001-4999, or W-J-4001-4999	W-K-4001-4999	W-L-4001-4999	
INSULATED PIPES	C-AJ-5001-5999 or F-A-5001-5999	C-BJ-5001-5999, C-BK-5001-5999, or F-B-5001-5999	F-C-5001-5999	F-E-5001-5999	C-AJ-5001-5999, C-BJ-5001-5999, or W-J-5001-5999	C-BK-5001-5999	W-L-5001-5999	W-N-5001-5999
MISCELLANEOUS ELECTRICAL PENETRANTS	C-AJ-6001-6999 or F-A-6001-6999	C-BJ-6001-6999			C-AJ-6001-6999, C-BJ-6001-6999, or W-BJ-6001-6999		W-L-6001-6999	
MISCELLANEOUS MECHANICAL PENETRANTS	C-AJ-7001-7999 or F-A-7001-7999	C-BJ-7001-7999 or F-B-7001-7999	F-C-7001-7999	F-E-7001-7999	C-AJ-7001-7999, C-BJ-7001-7999, or W-J-7001-7999		W-L-7001-7999	W-N-7001-7999
GROUPINGS OF PENETRATIONS	C-AJ-8001-8999 or F-A-8001-8999	C-BJ-8001-8999 or F-B-8001-8999	F-C-8001-8999	F-E-8001-8999	C-AJ-8001-8999, C-BJ-8001-8999, or W-J-8001-8999		W-L-8001-8999	

Remarks: For each location where a fire-resistance-rated floor or wall assembly is penetrated, provide a UL-listed penetration firestopping system selected from the applicable UL number range listed above that complies with Section 078413 "Penetration Firestopping" and that is suitable for the penetration conditions indicated for the Project.

SECTION 07 84 43 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fire-resistive joint systems for the following:

1. Floor-to-floor joints.
2. Floor-to-wall joints.
3. Head-of-wall joints.
4. Bottom of wall joints.
5. Wall-to-wall joints.

1.2 COORDINATION

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

1.3 ACTION SUBMITTALS

A. Product Data: Submit product data for each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Fire Resistive Joint System Schedule: Submit, for information only, a Fire Resistive Joint Schedule indicating the type of fire resistive joint system to be installed for each joint. Indicate each kind of construction condition. Include fire resistive joint design designation of testing and inspection agency acceptable to the authorities having jurisdiction that evidences compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each fire-resistive joint system configuration for construction and penetrating items.

B. Product Certificates: Signed by manufacturers of fire resistive joint system products certifying that products furnished comply with requirements.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified or licensed by the fire resistive joint system manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements. A manufacturer's willingness to sell its fire resistive joint system materials to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.

B. Source Limitations: Obtain fire-resistive joint systems, for each kind of joint and construction condition indicated, through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide fire-resistive joint systems that comply with the following requirements and those specified in Part 2 "Performance Requirements" Article:

1. Fire-resistance tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for fire-resistive joint systems acceptable to authorities having jurisdiction.
2. Fire-resistive joint systems are identical to those tested per methods indicated in Part 2 "Performance Requirements" Article and comply with the following:

    a. Fire-resistive joint system products bear classification marking of qualified testing and inspecting agency.
    b. Fire-resistive joint systems correspond to those indicated by referencing system designations of the qualified testing and inspecting agency.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fire-resistive joint system products to Project site in original, unopened containers or packages with qualified testing and inspecting agency's classification marking applicable to Project and with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for fire-resistive joint systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet.

B. Ventilate fire-resistive joint systems per manufacturer's written instructions by natural means or, if this is inadequate, forced-air circulation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly in which fire-resistive joint systems are installed.

B. Joint Systems In and Between Fire Resistance Rated Constructions: Provide systems with assembly ratings not less than that equaling or exceeding fire-resistance rating of constructions in which joints are located, as determined by UL 2079.

2.2 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide fire resistive joint systems indicated for each application in the Fire-Resistive Joint System Schedule at the end of Part 3.

2.3 JOINT FIRESTOPPING

A. Compatibility: Provide joint firestopping systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by fire-resistive joint system manufacturer based on testing and field experience.

B. VOC Content: Provide joint firestopping systems that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.
4. Plastic Foam Adhesives: 50 g/L.
5. Adhesives for Porous Materials (Except Wood): 50 g/L.
6. Fiberglass Adhesives: 80g/L.
7. Primers, Sealers and Undercoaters: 200 g/L.

C. Accessories: Provide components of joint firestopping system, including forming materials, that are needed to install fill materials and to comply with Part 2 "Performance Requirements" Article. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing and inspecting agency for systems indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of Work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from fire-resistive joint system materials. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates or damaging adjoining surfaces.

3.3 INSTALLATION

A. Install joint firestopping systems to comply with Part 2 "Performance Requirements" Article and fire-resistive joint system manufacturer's written installation instructions for products and applications indicated.

B. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
2. Apply fill materials so they contact and adhere to substrates formed by joints.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner may engage a qualified independent inspecting agency to inspect fire-resistive joint systems and to prepare inspection reports.

1. Inspecting agency will state in each report whether inspected fire-resistive joint systems comply with or deviate from requirements.

B. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and inspecting agency has approved installed fire-resistive joint systems.

C. If deficiencies are found, repair or replace fire-resistive joint systems so they comply with requirements.

3.5 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to joints as Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint 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 fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.6 JOINT FIRESTOPPING SYSTEM SCHEDULE

A. Designation System for Joints in or between Fire-Resistance-Rated Constructions: Alphanumeric designations listed in UL's "Fire Resistance Directory" under product Category XHBN.

B. Designation System for Joints at the Intersection of Fire-Resistance-Rated Floor or Floor/Ceiling Assembly: Alphanumeric designations listed in UL's "Fire Resistance Directory" under product Category XHDG.

C. Floor-to-Floor, Fire-Resistive Joint Systems: UL-Classified (FF-Series) system as required to maintain floor fire rating indicated.

D. Floor-to-Wall, Fire-Resistive Joint Systems: UL-Classified (FW-Series) system as required to maintain floor to wall fire rating indicated.

E. Head-of-Wall, Fire-Resistive Joint Systems: UL-Classified (HW-Series) system as required to maintain floor to wall fire rating indicated.

F. Bottom-of-Wall, Fire-Resistive Joint Systems: UL-Classified (BW Series) systems as required to maintain bottom of wall fire rating indicated.

G. Wall-To-Wall, Fire-Resistive Joint Systems: UL-Classified (WW-Series) system as required to maintain floor to wall fire rating indicated.

END OF SECTION 07 84 43

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes sealants for the following applications:

1. Exterior joints in the following vertical surfaces and nontraffic horizontal surfaces:

    a. Control and expansion joints in cast-in-place concrete.
    b. Control and expansion joints in unit masonry.
    c. Joints between metal panels.
    d. Joints between glass for structural glazing.
    e. Joints between different materials listed above.
    f. Perimeter joints between materials listed above and frames of doors and windows and louvers.
    g. Other joints as indicated.

2. Exterior joints in the following horizontal traffic surfaces:

    a. Control, expansion, and isolation joints in cast-in-place concrete slabs.
    b. Joints between different materials listed above.
    c. Other joints as indicated.

3. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:

    a. Control and expansion joints on exposed interior surfaces of exterior walls.
    b. Perimeter joints of exterior openings where indicated.
    c. Perimeter joints between interior wall surfaces and frames of interior doors, windows.
    d. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    e. Joints between glass and glass to adjoining walls.
    f. Other joints as indicated.

4. Interior joints in the following horizontal traffic surfaces:

    a. Control and expansion joints in cast-in-place concrete slabs.
    b. Other joints as indicated.

1.2 ACTION SUBMITTALS

A. Product Data: Submit product data for each joint-sealant product indicated and the following:

1. Written certification from manufacturers of joint sealants attesting that their products comply with specification requirements and are suitable for the use(s) indicated as verified through manufacturer'¢s in-house testing laboratory.

    a. Test results for all job specific concealed and exposed (custom colored) sealants confirming compatibility and adhesion are mandatory for all materials in contact with exterior glazing, curtain wall components, metal panels, prior to mockup and testing.
    b. Complete instructions for handling, storage, mixing, priming, installation, curing and protection of each type of sealant.

2. Laboratory and field test results confirming joint preparation (cleaning/priming), chemical compatibility, and proper adhesion for specified joint sealant for each of the joint profiles and substrate materials included in the design of this Project.

B. Samples: Submit samples of each type and color of exposed joint sealant required. Provide fully cured joint sealant samples in 3/4 inch (19 mm) wide joints 12 inches (300 mm) long formed between two strips of material to be sealed as they will appear on the Project.

1.3 INFORMATIONAL SUBMITTALS

A. Warranties: Submit specified warranties.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Exposed sealant work including, but not limited to, sealants used for air and weatherseals which are external to curtain wall systems at their perimeter, metal panel to panel joints at their perimeter, shall be performed by one firm specializing in the installation of sealants who has successfully produced work comparable to this Project, in not less than three projects of similar scope to the satisfaction of the Architect, and whose work has resulted in construction with a record of successful in-service performance for a period of 10 years. Concealed sealant work (sealants which are internal to curtain wall systems, metal panels, necessary for air and moisture penetration resistance under applied loads) shall be the responsibility of the subcontractor responsible for the final design, installation, and performance of the respective system.

B. Source Limitations: Obtain each type of joint sealant, and each type of structural silicone adhesive, from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 FIELD CONDITIONS

A. Environmental Limitations: 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 (4.4 deg C).
2. When joint substrates are wet.

B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealant work which has failed to provide a weathertight system within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Special Manufacturer's Warranties: Written warranties (weatherseal and stain resistance), signed by elastomeric sealant manufacturer agreeing to furnish elastomeric joint sealants to repair or replace those that fail to provide airtight and watertight joints, or fail in adhesion, cohesion, abrasion-resistance, stain-resistance, weather resistance, or general durability or appear to deteriorate in any other manner not clearly specified in the manufacturer's data as an inherent quality of the material within specified warranty period.

1. Warranty Period:

a. For Polyurethane Sealants: 5 years from date of Substantial Completion.
b. For Silicone Sealants: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, 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 stated by sealant manufacturer's published data, and as substantiated by the manufacturer for each application through testing.

B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: Not more than 250 g/L.
2. Nonmembrane Roof Sealants: 300 g/L.
3. Single-Ply Roof Membrane Sealants: 450 g/L.
4. Sealant Primers for Nonporous Substrates: Not more than 250 g/L.
5. Sealant Primers for Porous Substrates: Not more than 775 g/L.

C. Colors: For fully concealed joints, provide manufacturer's standard color of sealant which has the best overall performance characteristics for the application shown. For exposed joints provide custom colors to match Architect's samples of the following:

1. Exterior window and curtain wall framing, each color.
2. Metal panels, each color.
3. Exterior field applied paints and coatings, each color.
4. Other exterior and interior materials, each color as indicated.

D. Manufacturer's Representative: Do not use elastomeric sealant produced by a manufacturer who will not agree to send a qualified technical representative to the Project site when requested, for the purpose of rendering advice concerning the proper installation of manufacturer's materials.

2.2 ELASTOMERIC JOINT SEALANTS

A. Silicone Sealants for Vertical Applications (Non-Sag):

1. Typical Interior Glass Wall Butt Joints: Comply with ASTM C 1184 and ASTM C 920, Type S, Grade NS, Class 50; use NT, G, and A, black color unless otherwise indicated.

a. Products and Manufacturers: One of the following:

1) DOWSIL 795; Dow Chemical Company.
2) Spectrem 2; Tremco, an RPM Co.
3) Silpruf SCS 2000; Momentive.
4) Sika, Sikasil WS 295.

2. Typical Exterior Wall Joints:

    a. Properties:

        1) Standards: Comply with ASTM C 920, Type M or S, Grade NS, Class 25 or 50; use NT, M, A and O.
        2) Performance: Non-stain, non-bleed, non-streaking to sealed and adjacent substrates. The minimum peel adhesion value after 7 day immersion shall not be less than 13 pli (2.27 kN/m) when tested in strict accordance with ASTM C 794 Adhesion in Peel.
        3) Cure System and Oil Content: Neutral-cure, low or medium modulus system specifically manufactured with controlled oil content to eliminate oil migration into sealed substrates and residue rundown over and onto adjacent substrates.

    b. Products and Manufacturers: One of the following:

        1) DOWSIL 756 SMS; Dow Chemical Company.
        2) Spectrem 3 or Spectrem 4-TS (Use Spectrem 1 for metal to metal joints); Tremco, an RPM Co.
        3) Silpruf NB SCS 9000 (use Silpruf SCS 2000 for metal to metal joints); Momentive.

B. Two Part Polyurethane Sealants for Vertical Applications (Non-Sag):

1. Typical Exterior Wall Joints (Two-Part Polyurethane Sealants):

    a. Properties:

        1) Standards: Comply with ASTM C 920, Type M, Grade NS, Class 25 or Class 50; use NT, M, A and O.
        2) Performance: Non-stain, non-bleed, non-streaking to sealed and adjacent substrates. The minimum peel adhesion value after 7 day immersion shall not be less than 13 pli (2.27 kN/m) when tested in strict accordance with ASTM C 794 Adhesion in Peel.

    b. Products and Manufacturers: One of the following:

        1) BASF Master Builders; MasterSeal NP 2.
        2) Pecora Corporation; Dynatrol II.
        3) Tremco an RPM Co,; 240FC.

C. Two-Part Polyurethane Sealant for Paving Applications:

1. For Paving Applications with Slopes not Exceeding 5% (Self Leveling): ASTM C 920, Type M, Grade P, Class 25; use T (except with a Shore A hardness of 35 or greater) and I (Class 1 or 2) for water immersion; and abrasion resistant,; one of the following:

    a. Pecora Corporation; Urexpan NR-200.

b. Tremco, an RPM Co.; Vulkem, 445SSL.
c. Sika; Sikaflex 1c SL.

2. For Paving Applications with Slopes Exceeding 5%: ASTM C 920, Type M, Grade P "Slope Grade," Class 25; uses T (except with a Shore A hardness of 35 or greater) and I (Class 1 or 2) for water immersion; and abrasion resistant,; one of the following:

a. Pecora Corporation; Dynatred.
b. Tremco, an RPM Co.; Vulkem, 445SSL

D. Sealants for Contact with Food: Comply with 21 CFR 177.2600, NSF Standard 51, and ASTM C 920 for Type S, Grade NS, Class 25, Use NT.

1. Dow Chemical Company; 786 Silicone Sealant.

E. Mildew-Resistant Silicone Sealant (use for joints at toilet fixtures, toilet room countertops and vanities, and at janitor closet mop receptor to wall transition): Complying with ASTM C 920, Type S (single component), Grade NS (non-sag), class 25, Use NT (non-traffic), Substrate uses G, A, and O; and containing a fungicide for mildew resistance; white color.

1. Products: Provide one of the following:

a. Dow Chemical Company; 786 Silicone Sealant.
b. Momentive; Sanitary SCS 1700.
c. Pecora Corporation; 898 Silicone Sanitary Sealant.
d. Tremco, an RPM Co.; Tremsil 200 Sanitary.

2.3 LATEX JOINT SEALANTS

A. Latex Sealant: Non-elastomeric, one part, non-sag, paintable latex sealant that is recommended for exposed applications on the interior. Complying with ASTM C 834, Type OP (opaque sealants):

1. Products: Provide one of the following:

a. Pecora Corporation; AC-20 + Silicone.
b. DAP Products Inc.; Alex Plus Acrylic Latex Caulk Plus Silicone.
c. BASF; MasterSeal NP 520.
d. Tremco, an RPM Co.; Tremflex 834.

2.4 PREFORMED JOINT SEALANTS

A. Preformed Silicone-Sealant System: Provide one of the following.

1. DOWSIL 123 Silicone Seal set in DOWSIL 791, or DOWSIL 795 Silicone Sealants; Dow Chemical Company.
2. Sil-Span Preformed Silicone Profile set in 864-NST Silicone Sealant; Pecora Corporation.

3. Silicone Extruded Sheet set in Spectrem 1 adhesive for bite in either side; Tremco, an RPM Co.

2.5 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: One of the following preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding backings of flexible plastic foam complying with ASTM C 1330, and of type indicated below. Select shape and density of cylindrical sealant backings in consultation with the manufacturer for proper performance in specific condition of use in each case.

1. Type C: Closed-cell polyethylene foam material with a surface skin, which is nonabsorbent to liquid water and gas, non-outgassing in unruptured state; one of the following:

    a. HBR Closed Cell Backer Rod; Nomaco, Inc.
    b. MasterSeal 920; BASF Master Builders.
    c. Mile High Foam; Backer Rod Mfg., Inc.

2. Type B: Bi-cellular reticulated, polymeric foam material with a surface skin, nonoutgassing, with a density of between 1.5-3.0 pcf (24-48 kg/cubic meter) per ASTM D 1622 and minimum tensile strength of greater than 29-38 psi (200-267 kPa) per ASTM D 1623, and with water absorption less than 0.058 oz./cubic inch (0.10 gm/cc) per ASTM C 1016; one of the following:

    a. SofRod; Nomaco, Inc.
    b. MasterSeal 921; BASF Master Builders.
    c. Titan Foam; Backer Rod Mfg., Inc.

C. Bond-Breaker Tape: Polyethylene, TFE fluorocarbon, 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 where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

D. Weep and Vent Tubes: Clear plastic (PVC) tubing, minimum 1/4 inch (6.35 mm) inside diameter, and of length as required to extend between exterior face of sealant and open cavity behind.

1. At window and curtain wall systems, where required by system designer, provide gutter termination of tube with preformed nipples suitable for sealing to gutter.

E. Cork Joint Filler: Resilient and nonextruding, ASTM D 1752, Type II.

2.6 MISCELLANEOUS MATERIALS

A. Primer: Material recommended, as verified through compatibility and adhesion testing, by joint sealant manufacturer for the substrates indicated to be sealed.

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 with joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and which will not stain nor mar the finish of surfaces adjacent to joints to which it is applied.

PART 3 - EXECUTION

3.1 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 joint-sealant performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Silicone Glazing Sealants: Refer to Section 08 80 00 "Glazing."

B. 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 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), existing joint sealants, existing backer rods, existing waterproofing materials, existing water repellent treatments, oil, grease, water, surface dirt, and frost.
2. Clean concrete, masonry, unglazed surfaces of tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, 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 from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
3. Remove laitance and form-release agents from concrete.
4. Clean metal, glass, porcelain enamel, glazed surfaces of tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

C. Joint Priming (Elastomeric Sealants Only): Prime joint substrates with primers selected through the preconstruction compatibility and adhesion testing. 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.

D. 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 and primer smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

1. Silicone Glazing Sealants: Refer to Section 08 80 00 "Glazing" for installation.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:

1. Install sealant backings of type 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.

    a. Do not leave gaps between ends of sealant backings. Trim for tight fit around obstructions or elements penetrating the joint.
    b. Do not stretch, twist, puncture, or tear sealant backings.
    c. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry sealant backings.

2. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and back of joints.
3. Install weeps and vents into joints at the same time sealants are being installed. Unless otherwise shown on the drawings, or directed by the Architect, locate weeps and vents spaced as recommended by the sealant manufacturer and the window and curtain wall fabricator and erector. Do not install weeps and vents at outside building corners. Do not install vents at horizontal joints immediately below shelf angles, sills, and through wall flashings.

D. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.

1. Apply sealants in the depth shown or, if none is shown, apply in accordance with the manufacturer's recommendations and the following general proportions and limitations:

    a. Apply elastomeric sealants in sidewalk, pavement and similar horizontal joints to a depth equal to 75% of the joint width, but not less than 3/8 inch (10 mm) and not more than 3/4 inch (19 mm).
    b. Apply elastomeric sealants, in joints not subject to traffic or other abrasion, to a depth equal to 50% of the joint width, but not less than 1/4 inch (6 mm) and not more than 1/2 inch (13 mm).
    c. Apply non-elastomeric sealants to a depth approximately equal to the joint width.
    d. Fill horizontal traffic bearing joints slightly recessed to avoid direct contact with wheel, and pedestrian traffic. Fill horizontal traffic bearing joints with slope grade polyurethane sealants to a depth approximately equal to the joint width.

2. Pour self-leveling sealants to a depth approximately equal to the joint width.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform, beads to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces. Tool exposed surfaces of sealants to the profile shown, or if none is shown, tool slightly concave.

1. Use masking tape to protect adjacent surfaces of recessed tooled joints.
2. Provide a slight wash on horizontal joints where horizontal and vertical surfaces meet.
3. Against rough surfaces or in joints of uneven widths avoid the appearance of excess sealant or compound by locating the compound or sealant well back into joint wherever possible.

F. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:

1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
2. Apply a bead of silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's printed schedule and covering a bonded area of not less than a 3/8 inch (10 mm). Hold edge of sealant bead inside of masking tape by 1/4 inch (6 mm).
3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
4. Complete installation of horizontal joints before installing vertical joints. Lap vertical joints over horizontal joints. At end of joints, cut silicone extrusion with a razor knife.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field-test exterior wall joint-sealant adhesion to joint substrates as follows:

1. Perform 10 tests for the first 1000 feet (300 m) of joint length for each type of exposed exterior wall sealant and joint substrate.
2. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.

B. Field adhesion testing of sealants shall take place in the presence of a qualified technical representative of the sealant manufacturer.

1. Test Method: Test joint sealants by hand-pull method described below:

   a. Make knife cuts from one side of joint to the other, followed by two cuts approximately 3 inches (75 mm) long at sides of joint and meeting cross cut at one end. Place a mark 1 inch (25 mm) from cross-cut end of 3 inch (75 mm) piece.
   b. Use fingers to grasp 3 inch (75 mm) piece of sealant between cross-cut end and 1 inch (25 mm) mark; pull firmly at a 90-degree angle to the joint in the direction of side cuts and hold the sealant in this position for 10 seconds; following the 10 second time duration pull sealant at a 180 degree angle parallel to the joint and hold the sealant in this position for 10 seconds. Pull sealant away from joint to the distance recommended by sealant manufacturer for testing adhesion.
   c. For joints with dissimilar substrates, check adhesion to each substrate separately. Do this by extending cut along one side, checking adhesion to opposite side, and then repeating this procedure for opposite side.

2. The sealant manufacturer's qualified technical representative shall record test results, and observations of joint and sealant conditions, in a field adhesion test log.
3. Repair joint sealants pulled from test area as recommended by sealant manufacturer.
4. The sealant manufacturer shall provide written documentation of changes in product and/or application method required to address sealant failure, observe and document retesting as required by the Architect, and provide a written statement of compliance with applicable warranties.

C. Sealants not evidencing adhesive failure from testing 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.

3.5 CLEANING

A. Clean off excess sealants 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.

3.6 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 and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

3.7 JOINT SEALANT SCHEDULE

A. Exterior joints in the following vertical surfaces and nontraffic horizontal surfaces:

1. Perimeter joints between storefronts, aluminum window, metal framing and adjacent materials: Silicone Sealants for Vertical Applications (Non-Sag), Typical Exterior Wall Joints.
2. Control and expansion joints in cast-in-place concrete: Silicone Sealants for Vertical Applications (Non-Sag), Typical Exterior Wall Joints.
3. Control and expansion joints in unit masonry: Silicone Sealants for Vertical Applications (Non-Sag), Typical Exterior Wall Joints.
4. Joints between metal panels: Silicone Sealants for Vertical Applications (Non-Sag), Typical Exterior Wall Joints.
5. Joints between glass for structural glazing: Structural Glazing at Exterior Curtain Walls.
6. Joints between different materials listed above: Silicone Sealants for Vertical Applications (Non-Sag), Typical Exterior Wall Joints.
7. Perimeter joints between materials listed above and frames of doors and windows and louvers: Silicone Sealants for Vertical Applications (Non-Sag), Typical Exterior Wall Joints.

B. Exterior joints in the following horizontal traffic surfaces:

1. Control, expansion, and isolation joints in cast-in-place concrete slabs: Two-Part Polyurethane Sealant for Paving Applications.
2. Control and Expansion Joints in paving units, including steps and ramps: Two-Part Polyurethane Sealant for Paving Applications.
3. Joints between different materials listed above: Two-Part Polyurethane Sealant for Paving Applications.

C. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:

1. Control and Expansion Joints on Exposed Interior Surfaces of Exterior Walls: Latex sealant.
2. Perimeter Joints of Exterior Openings Where Indicated: Latex sealant.
3. Vertical Control and Expansion Joints in Tile Surfaces: Latex sealant.
4. Horizontal Control and Expansion Joints in Tile Flooring Surfaces: Two-Part Polyurethane Sealant for Paving Applications.
5. Vertical Control Joints on Exposed Surfaces of Interior Unit Masonry and Concrete Walls and Partitions: Latex sealant.

6. Perimeter Joints between Interior Wall Surfaces and Frames of Interior Doors, Windows, and Elevator Entrances: Latex sealant.
7. Perimeter Joints between Scalloped, Bent, or Warped Interior Wallboard Surfaces and Straight Trim: Latex Sealant.
8. Joints between Plumbing Fixtures and Adjoining Walls, Floors, and Counters: Mildew resistant silicone sealant.
9. Joints between Glass, and between Glass and Adjacent Substrates: Butt glazing sealant.

END OF SECTION 07 92 00

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes hollow metal doors and frames.

1. The integration of a security system into the hollow metal door and frame work is required. The Contractor shall be responsible for the total and complete coordination of the security system components into the Work.

1.2 ACTION SUBMITTALS

A. Product Data: Submit product data for each product indicated. Include material descriptions, core descriptions, label compliance, sound and fire-resistance ratings, and finishes for each type of door and frame specified.

B. Shop Drawings: Submit door and frame schedule using same reference designations indicated on Drawings. Include opening size(s), handing of doors, frame throat dimensions, details of each frame type, elevations of door design types, details of construction, location and installation requirements of door hardware and reinforcements, hardware group numbers, details of joints and connections, fire label requirements including fire rating time duration, maximum temperature rise requirements, and smoke label requirements.

1. Indicate routing of electrical conduit and dimensions and locations of cutouts in doors and frames to accept electric hardware devices.

C. Construction Samples: Submit approximately 18 by 24 inches (450 by 600 mm) construction samples, representing the required construction of doors and frames for Project.

1. Doors: Show vertical-edge, top, and bottom construction; insulation; face stiffeners; and hinge and other applied hardware reinforcement. Include louver section and glazing stops if applicable.
2. Welded Frames: Show profile, welded corner joint, welded hinge reinforcement, dust-cover boxes, floor and wall anchors, stops, and silencers. Include panel and louver sections and glazing stops if applicable.

1.3 INFORMATIONAL SUBMITTALS

A. Certificate of Compliance for Fire Rated Doors: Provide copies of Certificate of Compliance for all fire rated door assemblies, all smoke and draft control door assemblies, and all temperature rise rated door assemblies.

1.4 QUALITY ASSURANCE

A. Hollow Metal Door and Frame Standard: Comply with the applicable provisions and recommendations of the following publications by Hollow Metal Manufacturers Association (HMMA) Div. of National Association of Architectural Metal Manufacturers (NAAMM), unless more stringent requirements are indicated in the Contract Documents:

1. HMMA "Hollow Metal Manual."
2. HMMA 861 "Guide Specifications for Commercial Hollow Metal Doors and Frames."

B. Manufacturer Qualifications: A firm experienced in manufacturing hollow metal doors and frames similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 or UL 10C "Standard for Positive Pressure Fire Tests of Door Assemblies." Fire classification labels at all doors with fire ratings greater than 20 minutes shall indicate the temperature rise developed on the unexposed surface of the door after the first 30 minutes of fire exposure.

1. Provide metal labels permanently fastened on each door which is within the size limitations established by the labeling authority having jurisdiction.
2. Temperature-Rise Rating: Where indicated, provide doors that have a temperature-rise rating of 450 deg F (250 deg C) maximum in 30 minutes of fire exposure.
3. Positive Pressure Rated Door Assemblies: Where indicated provide positive pressure rated fire rated door assemblies. Sizes and configurations as shown on the Drawings. Installed door assemblies shall be in accordance with door manufacturer's certified assemblies.

    a. Test Pressure: Test according to NFPA 252 or UL 10C. After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches (1000 mm) or less above the sill.

D. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palleted, wrapped, or crated to provide protection during transit and Project site storage.

B. Inspect doors and frames, on delivery, for damage. Tool marks, rust, blemishes, and other damage on exposed surfaces will not be acceptable. Remove and replace damaged items as directed by Architect. Store doors and frames at building site in a dry location, off the ground, and in such a manner as to prevent deterioration.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide doors and frames by one of the following:

1. Hollow Metal Doors and Frames:

a. Ceco Door Products; an Assa Abloy Group Company.
b. Curries Company; an Assa Abloy Group Company.
c. Steelcraft; an Allegion PLC Company.

2.2 MATERIALS

A. Hot-Rolled Steel Sheets: ASTM A 1011/A 1011M, CS (commercial steel), Type B, free from scale, pitting, coil breaks, surface blemishes, buckles, waves, or other defects, exposed (matte) dull finish, suitable for exposed applications.

B. Cold-Rolled Steel Sheets: ASTM A 1008/A 1008M, CS (commercial steel), Type B; free of scale, pitting, or surface defects; pickled and oiled. Not less than 16 gauge, (0.053 inch) (1.3 mm) thick where frames are indicated to be built into exterior walls, hot dip galvanize after fabrication in compliance with ASTM A153/A153M, Class B.

C. Metallic-Coated Steel Sheets: ASTM A 653/A 653M, CS (commercial steel), Type B; with G60 (Z180) zinc (galvanized) or A60 (ZF180) zinc-iron-alloy (galvannealed) coating, mill phosphatized.

D. Inserts, Bolts, and Fasteners: Galvanized or cadmium plated steel.

1. Expansion Bolts and Shields: FS FF-S-325, Group III, Type 1 or 2.
2. Machine Screws: FS FF-S-92, carbon steel, Type III cross recessed, design I or II recess, style 2C flat head.

E. Filler: Sound deadening and heat retarding mineral fiber insulating material.

F. Glass and Glazing: Refer to Section 08 80 00 "Glazing."

G. Hardware: Refer to Section 08 71 00 "Door Hardware".

2.3 DOORS

A. General: Provide flush-design doors, 1-3/4 inches (44 mm) thick, of seamless hollow construction, unless otherwise indicated. Construct doors with sheets joined at their vertical edges by continuous welding the full height of the door, or joined at vertical edges by 1 inch (25.4 mm) spot welds 6 inches (150 mm) on center, or intermittently welded seams. Voids between spot and intermediate welds shall be epoxy edge filled Grind and finish all welds and edge fills flush to result in invisible seams on the door faces or vertical door edges.

1. Visible joints or seams around glazed or louvered panel inserts are permitted.
2. For single-acting swing doors, bevel both vertical edges 1/8 inch in 2 inches (3 mm in 50 mm).

B. Interior Door Core Construction: Doors shall be stiffened by continuous vertically formed steel sections which, upon assembly, shall span the full thickness of the interior space between door faces. These stiffeners shall be 0.026-inch (0.6-mm) minimum thickness, spaced so that the vertical interior webs shall be not more than 6 inches (150 mm) apart and spot welded to face sheets a maximum of 5 inches (127 mm) o.c. Place filler between stiffeners for full height of door.

C. Fire Door Cores: A continuous mineral fiberboard core permanently bonded to the inside face of the outer face sheet unless otherwise required to provide fire-protection and temperature-rise ratings indicated.

D. Astragals: As required by NFPA 80 to provide fire ratings indicated.

E. Top and Bottom Channels: Spot weld metal channel not less than thickness of face sheet to face sheets not more than 6 inches (150 mm) o.c.

1. Reinforce tops and bottoms of doors with inverted horizontal channels of same material as face sheet so flanges of channels are even with bottom and top edges of face sheets.

F. Hardware Reinforcement: Fabricate reinforcing from the same material as door to comply with the following. Offset reinforcement so that faces of mortised hardware items are flush with door surfaces.

1. Hinges and Pivots: 7 gauge (0.167 inch) (4.2 mm) thick by 1-1/2 inches (38 mm) wide by 9 inches (229 mm).
2. Lock Front, Strike, and Flushbolt Reinforcements: 12 gauge (0.093 inch) (2.3 mm) thick by size as required by hardware manufacturer.
3. Lock Reinforcement Units: 14 gauge (0.067 inch) (1.7 mm) thick by size as required by hardware manufacturer.
4. Closer Reinforcements: 12 gauge (0.093 inch) (2.3 mm) thick one-piece channel by size as required by hardware manufacturer.
5. Other Hardware Reinforcements: As required for adequate strength and anchorage.
6. In lieu of reinforcement specified, hardware manufacturer's recommended reinforcing units may be used.

G. Electrical Requirements: Make provisions for installation of electrical items specified elsewhere; arrange so wiring can be readily removed and replaced.

1. Provide all cutouts and reinforcements required for hollow metal doors to accept security system components.
2. Doors with Electric Hinges and Pivots: Provide with metal conduit or raceway to permit wiring from electric hinge or pivot to other electric door hardware.

    a. Hinge Location: Center for doors less than 90 inches (2286 mm) tall or second hinge from door bottom for doors greater than 90 inches (2286 mm); top or bottom electric hinge locations shall not be permitted.

H. Interior Hollow Metal Doors:

1. Typical Interior Doors: Flush design with 18 gauge (0.042-inch-) (1.06-mm-) thick cold-rolled stretcher-leveled steel face sheets and other metal components from hot- or cold-rolled steel sheets.
2. Extra Heavy Use Doors: Flush design with 14 gauge (0.067-inch-) (1.7-mm-) thick cold-rolled, stretcher-leveled steel face sheets and other metal components from hot- or cold-rolled steel sheets. Provide only where indicated.

2.4 FRAMES

A. Fabricate hollow metal frames, formed to profiles indicated, with full 5/8 inch (16 mm) stops, and of the following minimum thicknesses.

1. For interior use, form frames from cold- rolled steel sheet of the following thicknesses:

    a. Openings up to and Including 48 Inches (1200 mm) Wide: 16 gauge (0.053 inch) (1.3 mm).
    b. Openings More Than 48 Inches (1200 mm) Wide: 14 gauge (0.067 inch) (1.7 mm).

2. Frame heads at all masonry openings shall be formed to extend to the lowest CMU horizontal mortar joint.

B. Provide frames either saw mitered and full (continuously) profile welded, or machine mitered and full profile welded, on back side at frame corners and stops with edges straight and true. Grind welds smooth and flush on exposed surfaces.

C. Hardware Reinforcement: Fabricate reinforcements from same material as frame to comply with the following. Offset reinforcement so that faces of mortised hardware items are flush with surface of the frame.

1. Hinges and Pivots: 7 gauge (0.167 inch) (4.2 mm) thick by 1-1/4 inches (32 mm) wide by 10 inches (254 mm).
2. Strike, Surface Mounted Hold Open Arms, and Flushbolt Reinforcements: 12 gauge (0.093 inch) (2.3 mm) thick by size as required by hardware manufacturer.

3. Closer Reinforcements: 12 gauge (0.093 inch) (2.3 mm) thick one piece channel by size as required by hardware manufacturer.
4. Other Hardware Reinforcements: As required for adequate strength and anchorage.

D. Electrical Requirements: Make provisions for installation of electrical items specified elsewhere; arrange so wiring can be readily removed and replaced.

1. Provide all cutouts and reinforcements required for steel frames to accept security system components.
2. Frames with Electric Hinges and Pivots: Provide welded on UL listed back boxes with metal conduit or raceway to permit wiring from electric hinge or pivot to other electric door hardware.

    a. Hinge Location: Center for doors less than 90 inches (2286 mm) tall or second hinge from door bottom for doors greater than 90 inches (2286 mm); top or bottom electric hinge locations shall not be permitted.

E. Mullions and Transom Bars for Sidelights, Transoms, and Borrowed Light Frames: Provide closed or tubular mullions and transom bars where indicated. Fasten mullions and transom bars at crossings and to jambs by butt welding. Reinforce joints between frame members with concealed clip angles or sleeves of same metal and thickness as frame.

F. Jamb Anchors: Locate jamb anchors above hinges and directly opposite on strike jamb as required to secure frames to adjacent construction. At metal stud partitions locate the additional jamb anchor below the top hinge.

1. Masonry Construction: Adjustable, corrugated or perforated, anchors to suit frame size; formed of same material and gauge thickness as frame; at non-rated frames use friction fit T-shaped anchors, at rated frames use anchors consisting of spot welded strap and adjustable anchor; with leg not less than 2 inches (50 mm) wide by 10 inches (250 mm) long. Unless closer spacing is required to meet the performance requirements furnish at least the number of anchors per jamb according to the following frame heights:

    a. Two anchors per jamb up to 60 inches (1500 mm) in height.
    b. Three anchors per jamb from 60 to 90 inches (1500 to 2250 mm) in height.
    c. Four anchors per jamb from 90 to 96 inches (2250 to 2400 mm) in height.
    d. One additional anchor per jamb for each 24 inches (600 mm) or fraction thereof more than 96 inches (2400 mm) in height.

2. Metal-Stud Partitions: Metal channel stud zee anchor sized to match stud width, welded to back of frames, formed of same material and gauge thickness as frame. Unless closer spacing is required to meet the performance requirements provide at least the number of anchors for each jamb according to the following heights:

    a. Three anchors per jamb up to 60 inches (1500 mm) in height.
    b. Four anchors per jamb from 60 to 90 inches (1500 to 2250 mm) in height.
    c. Five anchors per jamb from 90 to 96 inches (2250 to 2400 mm) in height.
    d. One additional anchor per jamb for each 24 inches (600 mm) or fraction thereof more than 96 inches (2400 mm) in height.

3. In-Place Concrete or Masonry: Anchor frame jambs with minimum 3/8-inch- (9-mm-) diameter countersunk flat head bolts into expansion shields or inserts 6 inches (150 mm) from top and bottom of each jamb with intermediate anchors spaced a maximum of 26 inches (650 mm) o.c. unless closer spacing is required to meet the performance requirements. Soffit face of frame shall be punched and dimpled to accept countersunk bolt head. Reinforce frame with spacer to prevent bowing. Bolt head shall be set slightly below soffit face, filled and ground smooth at time of installation.

G. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, formed of same material as frame, 12 gauge (0.093 inch) (2.3 mm) thick, and punched with two holes to receive two 0.375 inch (9.5 mm) fasteners. Where floor fill or setting beds occur support frame by adjustable floor anchors bolted to the structural substrate. Terminate bottom of frames at finish floor surface. Weld floor anchors to frames with at least 4 spot welds per anchor.

H. Head Strut Supports: Provide 3/8-by-2-inch (9-by-50-mm) vertical steel struts extending from top of frame at each jamb to supporting construction above. Bend top of struts to provide flush contact for securing to supporting construction above by bolting, welding, or other suitable anchorage. Provide adjustable wedged or bolted anchorage to frame jamb members to permit height adjustment during installation. Adapt jamb anchors at struts to permit adjustment.

I. Head Reinforcement: For frames more than 48 inches (1200 mm) wide in masonry wall openings, provide continuous steel channel or angle stiffener, 12 gauge (0.093 inch) (2.3 mm) thick for full width of opening, welded to back of frame at head. Head reinforcements shall not be used as a lintel or load-bearing member for masonry.

J. Spreader Bars: Provide removable spreader bar across bottom of frames to serve as bracing during shipment and handling and to hold frames in proper position do not tack weld bars to frames.

K. Door Silencer Holes: Drill strike jamb stop to receive three silencers on single door frames and for two silencers on double door frames. Insert plastic plugs in holes to keep holes clear during installation.

L. Plaster, Mortar and Grout Guards and Removable Access Plates: Provide minimum 26 gauge (0.016-inch-) (0.4-mm-) thick guards or dust-cover boxes of same material as frame, welded to frame at back of hardware cutouts to close off interior of openings and prevent mortar or other materials from obstructing hardware and hardware fastener installation and hardware operation. Provide removable access plates in the heads of frames to receive overhead concealed door closers.

2.5 LOUVERS

A. Door Louvers: Fabricate louvers and mount flush into doors without overlapping moldings on surface of door face sheets. Provide internal support as recommended by louver manufacturer. Prime paint steel louvers after fabrication.

1. Interior Louvers: Sightproof, stationary type, constructed of inverted V or Y-shaped blades formed of same material as door.

    a. Steel: 18 gauge (0.042 inch) (1.0 mm) thick.
    b. Stainless Steel: 0.0375 inch (0.95 mm) thick.

2. Fire-Rated Automatic Louvers: Sightproof louver inserts fabricated from 16 gauge (0.053-inch-) (1.3-mm-) thick steel, spring operated, and released by 135 deg F (57 deg C) fusible links listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by the same testing and inspecting agency that established fire-resistance rating of door assembly.

B. Louvered Panels: Provide for installation in frames where indicated.

1. Interior Louvers: 18 gauge (0.042-inch-) (1.06-mm-) thick steel sheet. Fabricate units with stationary, sightproof, inverted V-shaped blades and U-shaped frames; not less than 1-3/8 inches (35 mm) thick. Space louver blades not more than 3 inches (75 mm) o.c. Assemble units by welding.
2. Stainless-Steel Louvers: Fabricate from 0.0625-inch- (1.6-mm-) thick, stainless-steel sheet with stationary, weatherproof Z-shaped blades and U-shaped frames; 1-3/8 inches (35 mm) thick. Space louver blades not more than 2 inches (50 mm) o.c. Assemble units by welding.

2.6 STOPS AND MOLDINGS

A. Provide continuous stops and moldings around solid, glazed, and louvered panels where indicated.

B. Form fixed stops and moldings integral with frame, on the exterior (non-secured) side of the frame.

C. Provide removable stops and moldings formed of 20 gauge (0.032-inch-) (0.8-mm-) thick steel sheets matching hollow metal frames. Secure with countersunk oval head machine screws spaced uniformly not more than 12 inches (300 mm) o.c. Form corners with butted or mitered hairline joints.

D. Coordinate rabbet width between fixed and removable stops with type of glass or panel and type of installation indicated.

2.7 FABRICATION

A. Fabricate doors and frames rigid, neat in appearance, and free of defects, warp, wave, and buckle. Accurately form metal to sizes and profiles indicated. Accurately machine, file, and fit exposed connections with hairline joints. Weld exposed joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

B. Exposed Fasteners: Provide countersunk flat heads for exposed screws and bolts, unless otherwise indicated.

C. Hardware Preparation: Prepare doors and frames to receive hardware, including cutouts, reinforcement, mortising, drilling, and tapping, according to final hardware schedule and templates provided by hardware supplier. Secure reinforcement by spot welding. Comply with applicable requirements of ANSI/BHMA A156.115 and A156.115W specifications for door and frame preparation for hardware. Factory-reinforce doors and frames to receive surface-applied hardware. Factory drill and tap for surface-applied hardware, except at pushplates and kickplates provide reinforcing only.

1. Locate hardware as indicated on the Drawings or in Section 08 71 00 "Door Hardware" or, if not indicated, according to HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."

2.8 METALLIC-COATED STEEL FINISHES

A. General: Clean, treat and prime surfaces of fabricated steel door and frame work, inside and out, whether exposed or concealed in the construction.

B. Surface Preparation: Clean surfaces with non-petroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.

1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

C. Factory Priming for Field-Painted Finish: Apply shop primer immediately after surface preparation and pretreatment. Apply a sufficient number of coats, baked on, to obtain uniformly smooth exposed surfaces. Touch up surfaces having runs, smears, or bare spots.

1. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, lead- and chromate-free, primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for zinc-coated steel; compatible with substrate and field-applied finish paint system indicated.

2.9 STEEL SHEET FINISHES

A. General: Clean, treat and prime surfaces of fabricated steel door and frame work, inside and out, whether exposed or concealed in the construction.

B. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale, shavings, filings, and rust, if present, complying with SSPC-SP 3, "Power Tool Cleaning."

C. Factory Priming for Field-Painted Finish: Apply shop primer immediately after surface preparation and pretreatment. Apply a sufficient number of coats, baked on, to obtain uniformly smooth exposed surfaces. Touch up surfaces having runs, smears, or bare spots.

1. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, corrosion-inhibiting, lead- and chromate-free, universal primer complying with ANSI A250.10 acceptance criteria; compatible with substrate and field-applied finish paint system indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install doors and frames according to the referenced standards, the Architect reviewed shop drawings, and manufacturer's written recommendations and installation instructions.

B. Frames: Install frames where indicated. Extend frame anchorages below fills and finishes. Coordinate the installation of built-in anchors for wall and partition construction as required with other work.

1. Welded Frames:

a. Set masonry anchorage devices where required for securing frames to in-place concrete or masonry construction.

1) Set anchorage devices opposite each anchor location as specified and anchorage device manufacturer's written instructions. Leave drilled holes rough, not reamed, and free of dust and debris.

b. Placing Frames: Remove temporary spreader bars prior to installation of the frames. Set frames accurately in position; plumb; align, and brace securely until permanent anchors are set.

1) At concrete or masonry construction, set frames and secure in place with machine screws and masonry anchorage devices. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
2) Anchor bottom of frames to floors through floor anchors with threaded fasteners.
3) Field splice only at approved locations indicated on the shop drawings. Weld, grind, and finish as required to conceal evidence of splicing on exposed faces.

2. At fire-rated openings, install frames according to NFPA 80.

C. Doors:

1. Non-Fire Rated Doors: Fit non-fire-rated doors accurately in their respective frames, with the following clearances:

    a. Jambs and Head: 3/32 inch (2 mm).
    b. Meeting Edges, Pairs of Doors: 1/8 inch (3 mm).
    c. Bottom: 3/8 inch (9 mm), if no threshold or carpet.
    d. Bottom: 1/8 inch (3 mm), at threshold or carpet.

2. Fire-Rated Doors: Install with clearances as specified in NFPA 80.
3. Smoke Control Doors: Install according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 08 80 00 "Glazing" and with hollow metal manufacturer's written instructions.

1. Secure stops with countersunk flat or oval head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (50 mm) o.c. from each corner.

E. Wood Door Installation: Refer to 08 14 16 "Flush Wood Doors."

F. Apply hardware in accordance with hardware manufacturer's instructions and Section 08 71 00 "Door Hardware." Drill and tap for machine screws as required. Do not use self tapping sheet metal screws. Adjust door installation to provide uniform clearance at head and jambs, and to contact stops uniformly. Adjust hardware items just prior to final inspection. Leave work in complete and proper operating condition.

1. Field cut existing hollow metal doors and frames indicated to receive new hardware. Field cutting shall be executed in a workmanlike manner and shall not void the existing door and frame labeling.

3.2 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items just before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including doors or frames that are warped, bowed, or otherwise unacceptable.

B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

1. Finish Painting: Refer to Section 09 91 23 "Interior Painting.""

C. Remove and replace defective work, including doors or frames that are warped, bowed, or otherwise defective.

D. Institute protective measures required throughout the remainder of the construction period to ensure that the hollow metal doors and frames will be without damage or deterioration, at time of Substantial Completion.

END OF SECTION 08 11 13

SECTION 08 12 16 - INTERIOR ALUMINUM DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes extruded aluminum doors and frames for interior locations.

1.2 ACTION SUBMITTALS

A. Product Data: Submit product data for each product indicated. Include material descriptions label compliance, fire resistance ratings for each type of door and frame specified.

B. Shop Drawings: Submit shop drawings showing scaled elevations, plans, and sections of the interior aluminum door and frame work. Show reinforcing at locations of hardware installation. Full scale sections shall be prepared and submitted for details of the assemblies that cannot be shown in the elevations or sections. Include with shop drawings glass thicknesses, metal finishes, and all other pertinent information as necessary or requested by the Architect to indicate compliance with the Contract Documents. Details of field connections, fire label requirements including fire rating time duration, anchorage, and their relationship to the work of others shall be clearly indicated for the coordination of the work by other building trades. Details of fastening and sealing methods and product joinery shall be shown to ensure proper performance of the field installation.

C. Samples: Submit samples for each type of corner construction and each type of exposed finish required. Prepare samples from same material to be used for the Work. For finishes with normal color and texture variations, include sample sets showing full range of variations expected.

1.3 INFORMATIONAL SUBMITTALS

A. Certificate of Compliance for Fire Rated Door Frames: Provide copies of Certificate of Compliance for all fire rated door frames.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Subcontract the interior door and frame work to a firm who has successfully installed interior aluminum door and framing systems similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Source Limitations: Obtain aluminum doors and frames through one source from a single manufacturer with the capacity and resources to provide products of consistent quality in appearance and physical properties.

C. Fire-Rated Door Frames: Frames complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 or UL 10C "Standard for Positive Pressure Fire Tests of Door Assemblies."

1. Provide metal labels permanently fastened on each door frame which is within the size limitations established by the labeling authority having jurisdiction.
2. Positive Pressure Rated Door Frames: Where indicated provide positive pressure rated fire rated door frames. Sizes and configurations as shown on the drawings. Installed door frames shall be in accordance with door manufacturers certified assemblies.

    a. Test Pressure: Test according to NFPA 252 or UL 10C. After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches (1000 mm) or less above the sill.

D. Product Options: Drawings indicate dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction dimensions. Other manufacturers' products complying with requirements may be considered. Refer to Section 01 60 00 "Product Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging of components shall be so selected to protect the components from damage during shipping and handling.

B. Storage on Site: Store components in a location and in a manner to avoid damage to the components. Keep handling on site to a minimum. Exercise particular care to avoid damage to finishes of metals.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify interior aluminum frame dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening and wall dimensions and note on shop drawings that these are not measured dimensions. Proceed with fabricating interior aluminum [**doors and**] frames without field measurements. Coordinate wall, floor, and ceiling construction to ensure that actual opening dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: The interior aluminum doors and frame work shown and specified is based on products by Western Integrated Materials, Inc. AlumaGlide Medium stile. Interior aluminum door and frame products, by the following manufacturers, similar to those described in the specifications and indicated on the drawings may be considered and is subject to the acceptance of the Architect.

1. Frameworks; Houston, TX.
2. Wilson Partitions, Vernon, CA.
3. Raco Interior Products, Inc., Houston, TX.

2.2 MATERIALS

A. Fabricate interior aluminum door and frame components from aluminum extrusions complying with ASTM B 221 (ASTM B 221M), 'Anodizing Quality' and formed to the sizes, shapes, and profiles indicated; temper required to suit structural and finish requirements.

2.3 ACCESSORIES

A. Fasteners: Aluminum, nonmagnetic stainless-steel or zinc plated steel complying with ASTM A 164.

B. Door Silencers (Mutes): Manufacturer's standard gray mohair.

C. Glazing Gaskets: Manufacturer's standard extruded or molded gray plastic or EPDM, to accommodate 1/4 inch (6 mm) thick glass at 4 side supported framing; provide 3/8 inch (10 mm) thick glass at 2 side supported framing where units are indicated to be 96 inches (2438 mm) or less in height, provide 1/2 inch (12 mm) thick glass at 2 side supported framing where units are indicated to be 120 inches (3048 mm) or less in height, unless otherwise indicated.

D. Copolymer Strips: A clear and continuous copolymer strip designed to reduce deflection between two-side supported glass units, with pre-applied clear high bond strength tape on both faces. Overall thickness of gap not to exceed 0.082 inch (2.1 mm).

1. C.R. Laurence: EZCC10 180 Degree Clear Partition Strips for 3/8 inch (10 mm) thick glass.
2. C.R. Laurence: EZCC12 180 Degree Clear Partition Strips provide 1/2 inch (12 mm) thick glass.

E. Glass: As specified in Section 08 80 00 "Glazing."

F. Hardware: As specified in Section 08 71 00 "Door Hardware."

1. 1-1/4" x 24" long straight 630 pull handle.
2. Accurate 2001-SDL3 sliding door lock with standard thumb turn.
3. Dual action, anti-slam soft close system.

2.4 SEALING MATERIALS

A. Exposed Sealing Materials: Acrylic latex type sealants, exposed at perimeter joints in contact with adjacent wallboard materials are specified in Section 07 92 00 "Joint Sealants."

2.5 FABRICATION

A. General: Fabricate the interior aluminum door and frames to the designs, shapes, and sizes shown using the materials specified and shown to produce assemblies which meet or exceed the performance requirements. To the greatest extent possible complete fabrication, assembly, finishing, hardware applications and other work before shipment to Project site.

1. Metal Wall Thickness: Provide shapes as shown and as required to suit the performance requirements but with wall thickness of not less than the following for each major component:

    a. Door Frames: Extruded aluminum, not less than 0.062 inch (1.575 mm) thick, reinforced for hinges and strikes.

        1) Locate hardware as required by fire-rated label for assembly.
        2) Fabricate aluminum frame assemblies with a cold-formed, primed, interior steel liner where required to comply with the fire resistance ratings indicated.

    b. Door Stiles and Rails: Extruded aluminum, not less than 0.125 inch (3.175 mm) thick, reinforced for hinges and strikes.
    c. Glass Frames: Extruded aluminum, not less than 0.062 inch (1.575 mm) thick, designed for glass thickness indicated.
    d. Ceiling Tracks: Extruded aluminum, not less than 0.062 inch (1.575 mm) thick.
    e. Trim: Extruded aluminum, not less than 0.050 inch (1.27 mm) thick, removable snap-in glass stops and door stops without exposed fasteners.
    f. Frame Face Dimension: As indicated on the Drawings.

2. Door Stile and Rail Dimensions:

    a. Bottomrails: 10 inches (254 mm).
    b. Stile Dimensions: As indicated on the Drawings.
    c. Top Rail Dimensions: As indicated on the Drawings.
    d. Door Thickness: 1-3/4 inches (44 mm).
    e. Fabricate all doors and frames to accommodate the swing direction shown.

3. Glazing shall be performed in accordance with Section 08 80 00 "Glazing."

B. Provide continuous glazing stops with concealed fasteners for all doors and frames. Provide stops with hairline joints at corners. Provide stops with square, not beveled, shouldered profile unless otherwise shown.

C. Cut, reinforce, drill and tap doors and frames in strict accordance with the printed door hardware manufacturers templates and instructions. Provide solid steel hardware reinforcements, securely fastened to doors and frames where door hardware is to be attached.

D. Joints in Metal Work: All exposed work shall be carefully fitted and matched to produce continuity of line and design, with all joints, being accurately fitted for hairline contact and rigidly secured.

1. Provide concealed corner reinforcements and alignment clips for precise butt or mitered connections.
2. Fabricate door stiles, door rails, and frames for glass to allow glass replacement without dismantling door or frame.
3. Fabricate all components to allow secure installation without exposed fasteners.

E. Shop Assembly: As far as practicable, all fitting and assembly work shall be done in a fabrication shop.

2.6 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish Application: Apply coatings to all exposed surfaces of interior aluminum [door and] frame work.

C. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

D. Protective and Decorative, Finishes: Complying with the following:

1. Metal Preparation and Pretreatment: Remove die markings prior to finishing operations. Perform this work in addition to the finish specified. Scratches, abrasions, dents and similar defects are unacceptable.
2. Colors:

a. Clear Anodized Finish: Medium matte (non-directional) finished, clear natural anodized complying with AA-M10C22A31 for an Architectural Class II finish.

1) Post Anodizing Finish (Sealing): Anodized finishes shall be fully sealed by the manufacturer or processor according to procedures recommended by the licensor of the process.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate interior aluminum door and frame work with the work of other Sections and provide items to be placed during the installation of other work at the proper time to avoid delays in the Work.

B. Place such items, including concealed overhead framing, accurately in relation to the final location of interior aluminum door and frame components.

3.2 EXAMINATION

A. Examine walls, floors, and ceilings for suitable conditions where interior aluminum doors and frames are to be installed.

B. Verify that wall thickness does not exceed standard tolerances allowed by throat size indicated.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Comply with interior aluminum door and frame manufacturer's written installation instructions and the Architect reviewed shop drawings. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints.

B. Frame Installation: Install frames plumb and square, shimmed and then securely anchored to substrates with fasteners recommended by frame manufacturer.

1. At fire-protection-rated openings, install interior aluminum frames according to NFPA 80.
2. Fasten to steel stud bulkhead framing using sheet metal screws or other fasteners approved by frame manufacturer in accordance with the accepted shop drawings.

    a. Use concealed installation clips to ensure that splices and connections are tightly butted and properly aligned.
    b. Secure clips to main structural extrusion components and not to snap-in or trim members.
    c. Do not leave screws or other fasteners exposed to view when installation is complete.

C. Doors: Doors shall be securely anchored in place to a straight, plumb and level condition, without distortion. Adjust doors to operate smoothly, without binding, with hardware functioning properly. Weatherstripping contact, and hardware movement, shall be field tested and final adjustment, and lubrication, made for proper operation and performance of doors.

1. Door Hardware: Refer to Section 08 71 00 "Door Hardware."
2. Install surface-mounted hardware according to manufacturer's written instructions using concealed fasteners to greatest extent possible.
3. Wood Door Installation: Refer to Section 08 14 16 "Flush Wood Doors."

D. Install glazing to comply with requirements of Section 08 80 00 "Glazing," unless otherwise indicated.

1. At two- and three-side supported glass units, install copolymer strips, in one continuous length, at each glass to glass panel vertical joint.

E. Install acrylic latex perimeter sealant to comply with requirements of Section 07 92 00 "Joint Sealants," unless otherwise indicated.

3.4 CLEANING

A. Clean exposed surfaces of interior aluminum doors and frames promptly after installation, using cleaning methods recommended by interior aluminum door and frame manufacturer.

1. Clean and maintain anodized aluminum according to AAMA 609.

B. Wash glass on both faces not more than 4 days prior to date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer. Remove excess glazing and sealant compounds, dirt, and other substances.

C. Immediately remove any deleterious material from surfaces of aluminum.

3.5 PROTECTION

A. Institute protective measures required throughout the remainder of the construction period to ensure that interior aluminum doors and frames work will be without damage or deterioration at time of acceptance.

END OF SECTION 08 12 16

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes solid core flush wood doors.

1. The integration of a security system into the flush wood door work is required. The Contractor shall be responsible for the total and complete coordination of the security system components into the Work.

1.2 ACTION SUBMITTALS

A. Product Data: Submit product data for each type of door required. Include factory-finishing specifications.

1. Submit laboratory test report results of hinge loading, cycle/slam, stile edge screw withdrawals, and stile edge split resistance for fire rated doors.

B. Shop Drawings: Submit shop drawings indicating location, size, thickness, and hand of each door; elevation of each kind of door; construction details not covered in the product data; location and extent of hardware blocking; undercuts, special beveling, and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware of factory machined doors.
2. Indicate dimensions and locations of cutouts.
3. Indicate fire label requirements including fire rating time duration, maximum temperature rise requirements, and smoke label requirements.
4. Indicate routing of electrical conduit and dimensions and locations of cutouts in wood doors to accept electric hardware devices.

C. Samples: Cut away corner section of each door type approximately 8 by 10 inches (200 by 250 mm) demonstrating door construction, face veneer and finish.

1.3 INFORMATIONAL SUBMITTALS

A. Certificate of Compliance for Fire Rated Doors: Provide copies of testing agency's Certificate of Compliance for all fire rated door assemblies, all smoke and draft control door assemblies, and all temperature rise rated door assemblies.

1.4 QUALITY ASSURANCE

A. Quality Standard: Comply with the applicable provisions and recommendations of AWI's "Architectural Woodwork Quality Standards Illustrated, 8th Edition, Version 2.0, Section 1300" where standards and specifications conflict the more stringent shall be required.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252, and UL 10C "Standard for Positive Pressure Fire Tests of Door Assemblies." Fire classification labels at all doors with fire ratings greater than 20 minutes shall indicate the temperature rise developed on the unexposed surface of the door after the first 30 minutes of fire exposure.

1. Provide metal labels permanently fastened on each door which is within the size limitations established by the labeling authority having jurisdiction.
2. Positive Pressure Rated Door Assemblies: Where indicated provide positive pressure rated fire rated door assemblies. Sizes and configurations as shown on the Drawings. Installed door assemblies shall be in accordance with door manufacturer's certified assemblies.

    a. Test Pressure: Test according to NFPA 252 or UL 10C. After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches (1000 mm) or less above the sill.

3. Provide fire rated door assemblies with smoke and draft control rating at corridors, stairwells, and where required by applicable codes. Sizes and configurations as shown on the Drawings. Installed door assemblies shall be in accordance with door manufacturer's certified assemblies.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect wood doors during transit, storage, and handling to prevent damage, soiling, and deterioration. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in heavy duty cardboard cartons or poly bags.

C. Handle wood doors with clean gloves. Lift and carry wood doors when moving them around the site, do not drag wood doors across one another.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until wet work , such as masonry, concrete, stone, tile, terrazzo, plastering, wallboard joint treatment, is complete and dried, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period. Do not expose doors to sudden changes in temperature such as forced heat used to dry out the site.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship for the life of the original installation of the door. A representative of the door manufacturer shall inspect the installed doors and shall note on the warranty that no provisions of the warranty have been nullified in the manufacture and/or installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance to requirements, provide products by one of the following:

1. Marshfield - Algoma by Masonite Architectural.
2. Eggers Industries, Architectural Door Division.
3. VT Industries.

2.2 DOOR CONSTRUCTION

A. General:

1. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain added formaldehyde.
2. Adhesives: Do not use adhesives that contain urea formaldehyde.
3. Composite Wood Products: Products shall be made without urea formaldehyde.

B. Doors for Opaque Finish:

1. Grade: Custom.
2. Face Veneer: Minimum 3 mil thick medium-density overlay (MDO) or high density fiberboard (HDF).
3. Thickness: 1-3/4 inch (45-mm) unless otherwise indicated.
4. Materials:

a. Particleboard Core Material: Complying with ANSI A208.1, Grade 1-LD-1 or 1-LD-2.
b. Blocking: 5-1/2 inch (138-mm) wide minimum top-rail blocking at doors with closers and bottom rail blocking at doors with kickplates consisting of minimum 1/2 inch (13-mm) wide single length structural composite lumber (SCL) outer band and single length SCL inner band.
c. Vertical Edges: 1-3/8 inch (35-mm) wide minimum prior to fitting, 2 ply laminated wood construction consisting of a single piece hardwood outer band, without fingerjoints, and an inner band of SCL. Trim non-rated door width equally on both jamb edges.
d. Crossbanding: Minimum 1/16 inch (1.5-mm) thick, low density hardwood, composite, or high density fiberboard (HDF).

5. Construction: AWI Section 1300, PC-5 CE. Stiles, rails, and blocking bonded to core then entire unit abrasive planed before veneering. Crossbanding materials shall extend full width of door with grain running horizontally, tapeless spliced without voids or show through (telegraphing), and directly glued to core and blocking. Sand crossbanding before application of face veneer. Face veneer shall extend full height of door with grain running vertically, tapeless spliced without voids or show through (telegraphing), and directly glued to cross band. Glue lines between face veneer, crossbanding, and blocking shall be of a type to comply with the specified warranty using the hot plate process.

C. Fire Rated Door Construction:

1. Construction: AWI Section 1300, FD-5, with particleboard or mineral core as required to provide fire rating indicated, and faced to match non-rated fire doors. Provide required label(s) on each door.
2. Blocking: For mineral-core doors, provide composite blocking, of same thickness as core, approved for use in doors of fire ratings indicated, and as follows:

a. 5-1/2 inch (138-mm) wide minimum top-rail blocking consisting of minimum 1/2 inch (13-mm) wide single length mill option hardwood outer band and single length lumber inner band fabricated of same materials as vertical edges.
b. Provide either two 4-1/2 inch (114-mm) by 18 inch (457-mm) minimum sized lock blocks on each door stile or a single 10 inch (254-mm) high continuous lock rail located on lockcase body centerlines.

3. Vertical Edge Construction: Provide manufacturer's standard laminated-edge construction meeting label requirements, with intumescent seals concealed by outer stile matching face veneer, and meeting or exceeding the specified direct screw withdrawal, split resistance, cycle slam, and hinge loading criteria. Finish outer bands to match door faces without joints.

a. Split Resistance: Not less than 696 pounds when tested in accordance with WDMA TM-5; or, not less than 1305 pounds when tested in accordance with ASTM D 143.

b. Cycle/Slam: Not less than 200,000 cycles with no loosening of hinge screws or other visible signs of failure when tested in accordance with the requirements of WDMA TM-7; or, not less than 502,000 cycles when tested in accordance with ANSI A151.1
c. Direct Screw Withdrawal: Not less than 700 pounds when tested in accordance with WDMA TM-10; or, not less than 877 pounds when tested in accordance with ASTM D 1037 using #12 x 1-1/4 steel screws, threaded to the head with either A or AB wood threads.
d. Hinge Loading: Not less than 684 pounds average when tested in accordance with WDMA TM-8.

4. Pairs: Provide fire-rated pairs with fire-retardant stiles matching face veneer that are labeled and listed for kinds of applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals.
5. Thickness: 1-3/4 inch (45-mm) unless otherwise indicated.

D. Wood Beads for Light Openings in Wood Doors: Manufacturer's standard flush designed, solid wood, rectangular shaped, back beveled or quirked, beads matching veneer species of door faces. Include glazing compounds or tapes sized for back bevel or quirk provided. Include finish nails for removable stops sized in accordance with wood door manufacturer's recommendations.

E. Wood-Veneered Beads for Light Openings in Fire Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire rating indicated. Include glazing compounds or tapes and concealed metal glazing clips for opening size and fire rating indicated. Include finish nails for removable stops sized as required for fire rating indicated.

2.3 FABRICATION

A. Fabricate doors in sizes indicated for Project-site fitting.

B. Factory fit doors to suit frame-opening sizes indicated.

1. Comply with clearance requirements of referenced quality standard for fitting. Comply with requirements in NFPA 80 for fire-rated doors.

C. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3 unless otherwise indicated to match existing frame hardware preparations. Comply with final hardware schedules, door frame Shop Drawings, AWI Section 1300-G-20, BHMA A156.115-W standards, and hardware templates.

1. Coordinate measurements of hardware mortises in frames to verify dimensions and alignment before factory machining.
2. Locate lock and latchsets in doors to match existing strike locations on existing door frames; locate hinges in doors to match hinge locations on existing door frames.
3. Metal Astragals: Premachine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

D. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required. Install light beads with fasteners spaced for opening size and fire rating indicated. Install wood bead moldings with finish nails and countersink without striking bead. Fill countersunk heads with putty matching wood bead color.

2.4 SHOP PRIMING

A. Doors for Opaque Finish: Shop prime faces and edges of doors, including cutouts, with one coat of wood primer/sealer as standard with door manufacturer. Surfaces shall be clean and dry before priming. Apply primer/sealer uniformly without bare spots, runs, or sags.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hardware: Apply hardware to new doors in accordance with hardware manufacturer's instructions and Section 08 71 00 "Door Hardware." For particleboard core doors drill pilot holes of proper size for installing hinge screws. Adjust hardware items just prior to final inspection. Leave work in complete and proper operating condition.

1. Factory wrapping shall be maintained on new doors during construction period, and all hardware shall be installed by cutting the factory wrapping at the mounting location of the hardware item.

B. General Door Installation Standards: Install doors in locations indicated to comply with manufacturer's written instructions, referenced quality standard, and as indicated. Where standards conflict the more stringent shall apply.

1. Install fire-rated doors in corresponding fire-rated frames according to fire label requirements.

C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels; and to contact stops uniformly, do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Field cutting, fitting or trimming, shall be executed in a workmanlike manner. Machine doors for hardware. Seal cut and trimmed surfaces immediately after fitting and machining using clear varnish or sealer.

1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold.
2. Comply with fire label requirements for fire-rated doors.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge, matching clearances specified for factory prefitting, and to contact stops uniformly. Field cutting, fitting or trimming, if required, shall be executed in a workmanlike manner.

1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold.

E. Existing Wood Doors (Salvaged from Alteration Work): Install salvaged existing wood doors in locations indicated. Field cutting, fitting or trimming, if required, shall be executed in a workmanlike manner.

F. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

G. Field-Finished Doors: Refer to the following for finishing requirements:

1. Section 09 91 23 "Interior Painting."

3.2 ADJUSTING AND PROTECTION

A. Rehang or replace doors that do not swing or operate freely.

B. Protection: Protect wood doors to ensure that the wood door work will be without damage or deterioration at the time of Substantial Completion.

1. Refinish or replace wood doors damaged during installation. Replace any new wood doors that are warped, twisted, demonstrate core show through, are not true in plane, or cannot be refinished to the satisfaction of the Architect.

END OF SECTION 08 14 16

SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes access doors and frames.

1.2 COORDINATION

A. Verification: Obtain specific locations and sizes for required access doors from trades requiring access to concealed equipment, and where shown on the drawings, and indicate on schedule specified in "Submittals" Article.

1.3 ACTION SUBMITTALS

A. Product Data: Submit product data for each type of access door and frame indicated. Include construction details relative to materials, individual components and profiles, finishes, and fire ratings (if required) for access doors and frames.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items with concealed framing, suspension systems, piping, ductwork, and other construction. Show the following:

1. Method of attaching door frames to surrounding construction.
2. Ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim.

B. Schedule: Provide complete door and frame schedule, including types, general locations, sizes, construction details, latching or locking provisions, and other data pertinent to installation.

1.5 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain access doors of each type for entire project from one source from a single manufacturer.

B. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 and that are labeled and listed by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction per test method indicated.

1. Vertical Access Doors: NFPA 252 or UL 10B.

C. Size and Location Verification: Determine specific locations and sizes for access doors needed to gain access to concealed equipment, and indicate on schedule.

PART 2 - PRODUCTS

2.1 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.

2.2 ACCESS DOORS AND FRAMES

A. Flush, Insulated, Fire-Rated Access Doors and Trimless Frames (AD##): Fabricated from steel sheet.

1. Locations: Gypsum board wall surfaces indicated to be fire rated.
2. Fire-Resistance Rating: One and one-half hours.
3. Temperature Rise Rating: 250 deg F (139 deg C) at the end of 30 minutes.
4. Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal.
5. Frame: Sheet metal with drywall bead.
6. Hinges: Continuous piano hinge.
7. Automatic Closer: Spring type.
8. Latch: Self-latching bolt operated by knurled knob with interior release.
9. Products: One of the following:

    a. Acudor Products, Inc.; FW-5050-DW Fire Rated for Drywall - Insulated.
    b. Larsen's Industries, Inc.; L-FRAP.
    c. Milcor; Style UFR-DW.
    d. Nystrom, Inc.; IW Series.

B. Flush Access Typical Doors and Trimless Frames for Vertical Surfaces (AD##): Fabricated from steel sheet.

1. Locations: Gypsum board wall surfaces.
2. Door: Minimum 14 gauge 0.067 inch (1.7 mm) thick sheet metal, set flush with surrounding finish surfaces.
3. Frame: Minimum 16 gauge 0.053 inch (1.3 mm) thick sheet metal with drywall bead.
4. Hinges: Continuous concealed type.
5. Latch: Flush, screwdriver- operated cam latch of number required to hold door in flush, smooth plane when closed.
6. Products: One of the following:

    a. Acudor Products, Inc.; DW-5040 Flush for Drywall.

b. Larsen's Industries, Inc.; Model L-DWC.
c. Milcor; Style DW.
d. Nystrom, Inc.; NW Series.

C. Flush Access Typical Doors and Trimless Frames for Horizontal Surfaces (AD##): Fabricated from glass fiber reinforced gypsum.

1. Locations: Gypsum board ceiling surfaces.
2. Door: Minimum 1/8 inch (3 mm) thick glass fiber reinforced gypsum, set flush with surrounding gypsum wallboard finish surfaces.
3. Frame: Minimum 1/8 inch (3 mm) thick glass fiber reinforced gypsum, with tapered square edge.
4. Hinges and Latch: None, lay-in manual push up type.
5. Product:

a. Acudor Products, Inc.; GFRG Recessed Access Door for Drywall Ceilings.
b. Chicago Metallic Ceiling Systems and Specialty Products: Glass Reinforced Gypsum Drywall Ceiling Access Doors.
c. Formglas, Inc.: Interior Ceiling Access Panel.
d. IntexForms Inc.; Series AP Access Panel.
e. Wind-Lock; Stealth Access Panels.

2.3 FABRICATION

A. General: Provide access door assemblies manufactured as integral units ready for installation.

B. Steel Access Doors: Fabricate units of continuous welded steel construction. Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.

1. Provide special sized access doors where required or requested.

C. Glass Fiber Reinforced Gypsum Doors: Fabricate units of monolithic glass fiber reinforced gypsum construction having a shell thickness of between 1/8 to 3/16 inch (3 to 4.8 mm) and weighing approximately 2 pounds per square foot. Edges of doors shall be rabbetted to overlap and rest on the frame.

1. Provide special sized access doors where required or requested.

D. Frames:

1. Exposed Flanges: Nominal 1 to 1-1/2 inches (25 to 38 mm) wide around perimeter of frame for steel frames.
2. Provide trimless carbon steel frames with drywall bead for installation in gypsum wallboard assembly, furnish perforated frames with drywall bead, securely attached to perimeter of frames, in size to suit thickness of gypsum panels indicated. Provide mounting holes in frames to attach frames to metal framing in drywall construction.

3. Provide trimless glass fiber reinforced frames with tapered edges for taping and joint compound installation into gypsum wallboard ceiling assembly, in size to suit thickness of gypsum panels used.

2.4 CARBON STEEL FINISHES

A. Surface Preparation: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

B. Apply shop primer to uncoated surfaces of metal fabrications. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's instructions for installation of access doors. Coordinate installation with work of other trades.

B. Advise installers of other work about specific requirements relating to access door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.

C. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.

D. Install access doors flush with adjacent finish surfaces or recessed to receive finish material.

E. Adjust doors and hardware after installation for proper operation.

F. Remove and replace panels or frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08 31 13

SECTION 08 36 13 - SECTIONAL OVERHEAD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes electrically operated bi-fold sectional doors.

B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for miscellaneous steel supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of sectional door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. Include diagrams for power, signal, and control wiring.

C. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:

1. Frame for paneled door sections; of each width of stile and rail required.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranties: For special warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sectional doors to include in maintenance manuals.

1.5 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.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Failure of components or operators before reaching required number of operation cycles.
c. Faulty operation of hardware.
d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
e. Delamination of exterior or interior facing materials.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

A. Source Limitations: Obtain sectional doors from single source from single manufacturer.

1. Obtain operators and controls from sectional door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Sectional doors shall comply with performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

1. Design Wind Load: As indicated on Drawings.
2. Testing: According to ASTM E 330.
3. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components.

    a. Deflection of door sections in horizontal position (open) shall not exceed 1/300 of the door width.
    b. Deflection of horizontal track assembly shall not exceed 1/240 of the door height.

4. Operability under Wind Load: Design overhead coiling doors to remain operable under uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa) wind load, acting inward and outward.

C. Seismic Performance: Sectional doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor: 1.0.

2.3 DOOR ASSEMBLY

A. Two Leaf Hinged Stacking Overhead Doors: Two horizontal panels hinged together, weather lapped at horizontal joint; rising vertically on roller and track system fixed to building structure to stack in a folded position under lintel.

1. Basis of Design Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Renlita Doors North America; A-750 Nu-Fold.

B. Framework: Welded construction fabricated from extruded hollow section aluminum members with minimum wall thickness of 0.125 inch (3.1 mm). Beams shall be designed for maximum dead load deflection of 1/300th part of the span.

C. Operating Channels fabricated from carbon steel hot rolled sheet to comply with ASTM A-36. Final finish on track in accordance with Part 2.4.

D. Counter Balancing: Counterweight system with enclosed counterweights suspended by 7/19 flexible multi-strand steel cables with minimum safety factor of 6:1. Cable shall be guided in steel sheaves with a minimum sheave to cable diameter ratio of 19:1. Sheaves shall be capable of carrying design loads.

E. Load is contained in the jambs and does not require a load bearing header or any additional lateral supports

F. Mechanical pin lock fail-safe device that prevents door movement automatically in

G. the event of a counterbalance or lifting device failure. Safety brake shall automatically reset once repairs are completed and be capable of repeated engagementwithout replacement of brake or components.

H. Construct steel door sections from carbon steel hot rolled tube complying with ASTM A-513 Type 1 and ASTM A-36.

I. Counterweight Covers: Counterweights shall be protected and covered with a removablepressed sheet (aluminum or steel).

J. Locking Devices:

1. Internal slide locks, unless otherwise specified.

K. Electric Door Operator:

1. Operator Type: Manufacturer's standard for door requirements.
2. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet (2.4 m) or lower.
3. Motor Exposure: Interior, clean, and dry.
4. Emergency Manual Operation: Chain type.
5. Obstruction-Detection Device: Automatic pneumatic sensor edge on bottom section.

    a. Sensor Edge Bulb Color: Black.

6. Control Station: Interior-side mounted.

L. Door Finish:

1. Baked-Enamel or Powder-Coat Finish: Color and gloss as selected by Architect from manufacturer's full range.

2.4 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 ALUMINUM DOOR SECTIONS

A. Sections: Extruded-aluminum stile and rail members with dimensions and profiles as indicated on Drawings; members joined by welding or with concealed, 1/4-inch- (6-mm-) minimum diameter, aluminum or nonmagnetic stainless-steel through bolts, full height of door section; and with meeting rails shaped to provide a weather-resistant seal.

1. Aluminum: ASTM B 221 (ASTM B 221M) extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; minimum thickness 0.065 inch (1.7 mm) for door section 1-3/4 inches (44 mm) deep, and as required to comply with requirements.
2. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Ensure that reinforcement does not obstruct vision lites.
3. Provide reinforcement for hardware attachment.

B. Full-Vision Sections: Manufacturer's standard, tubular, aluminum-framed section fully glazed with 6-mm-thick, clear acrylic glazing set in vinyl, rubber, or neoprene glazing channel and with removable extruded-vinyl or aluminum stops.

2.6 TRACKS, SUPPORTS, AND ACCESSORIES

A. Tracks: Manufacturer's standard, galvanized-steel track system of configuration indicated, sized for door size and weight, designed for lift type indicated and clearances indicated on Drawings, Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides for required door type, size, weight, and loading.

1. Galvanized Steel: ASTM A 653/A 653M, minimum G60 (Z180) zinc coating.
2. Slope tracks at an angle from vertical or design tracks to ensure tight closure at jambs when door unit is closed.
3. Track Reinforcement and Supports: Galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches (51 mm) apart for door-drop safety device.

    a. For Vertical Track: Continuous reinforcing angle attached to track and attached to wall with jamb brackets.
    b. For Horizontal Track: Continuous reinforcing angle from curve in track to end of track, attached to track and supported at points by laterally braced attachments to overhead structural members.

B. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of sectional door unless otherwise indicated.

2.7 HARDWARE

A. General: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.

B. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch- (2.01-mm-) nominal coated thickness at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible. Provide double-end hinges where required, for doors more than 16 feet (4.88 m) wide unless otherwise recommended by door manufacturer.

C. Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 3-inch- (76-mm-) diameter roller tires for 3-inch- (76-mm-) wide track and 2-inch- (51-mm-) diameter roller tires for 2-inch- (51-mm-) wide track.

2.8 LOCKING DEVICES

A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded deadbolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: Cylinders specified in Section 08 71 00 "Door Hardware" and keyed to building keying system.
2. Keys: Three for each cylinder.

B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.9 COUNTERBALANCE MECHANISM

A. Weight Counterbalance: Counterbalance mechanism consisting of filled pipe weights that move vertically in a galvanized-steel weight pipe. Connect pipe weights with cable to weight-cable drums mounted on torsion shaft made of steel tube or solid steel.

B. Cable Drums and Shaft for Doors: Cast-aluminum or gray-iron casting cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft. Provide one additional midpoint bracket for shafts up to 16 feet (4.88 m) long and two additional brackets at one-third points to support shafts more than 16 feet (4.88 m) long unless closer spacing is recommended by door manufacturer.

C. Cables: Galvanized-steel, multistrand, lifting cables with cable safety factor of at least 7 to 1.

D. Cable Safety Device: Include a spring-loaded steel or spring-loaded bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either lifting cable breaks.

E. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.

F. Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.

2.10 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. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Chamberlain Group, Inc. (The); Liftmaster 3900 Jackshaft Operator

2. Comply with NFPA 70.
3. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door-Operator Type: Unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed to operate door and meet required usage classification.

1. Trolley: Trolley operator mounted to ceiling above and to rear of door in raised position and directly connected to door with drawbar.

D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.

1. Electrical Characteristics:

    a. Phase: Single phase.
    b. Volts: 115 V.
    c. Hertz: 60.

2. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.
3. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
5. Use adjustable motor-mounting bases for belt-driven operators.

E. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

F. Obstruction Detection Device: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.

1. Pneumatic Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device.

G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure, push-button control labeled "Close."

1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.

H. Emergency Manual Operation: Equip electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N).

I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

2.11 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.12 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, application, and baking.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Tracks:

1. Fasten vertical track assembly to opening jambs and framing, spaced not more than 24 inches (610 mm) apart.
2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

D. Power-Operated Doors: Install according to UL 325.

3.3 STARTUP SERVICES

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.

D. Touch-up Painting: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A 780/A 780M.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION 08 36 13

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes door hardware.

1.2 PREINSTALLATION MEETINGS

A. Keying Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:

1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
2. Preliminary key system schematic diagram.
3. Requirements for key control system.
4. Address for delivery of keys.

B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to electrified door hardware including, but not limited to, the following:

1. Inspect and discuss electrical roughing-in and other preparatory work performed by other trades.
2. Review sequence of operation for each type of electrified door hardware.
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. Review required testing, inspecting, and certifying procedures.

1.3 ACTION SUBMITTALS

A. Product Data: Submit product data including installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Submit shop drawings with details of electrified door hardware, indicating the following:

1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring. Include the following:

a. System schematic.
b. Point-to-point wiring diagram.

c. Riser diagram.
d. Elevation of each door controlled by electrified hardware.

2. Detail interface between electrified door hardware and fire alarm, access control, security, and building control system.

C. Samples: Submit samples of exposed door hardware for each type indicated below, in specified finish. Tag with full description for coordination with the Door Hardware Schedule.

1. Door Hardware: As follows:

a. Locks and latches.
b. Operating trim.
c. Wall stops.
d. Floor stops.
e. Magnetic latches.
f. Coat hooks.

2. Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.

D. Door Hardware Schedule: Submit door hardware schedule prepared by or under the supervision of door hardware supplier. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware. The Architect's review of schedule shall neither be construed as a complete check nor shall it relieve the Contractor of responsibility for errors, deviations, or omissions from the specified requirements to provide complete door hardware for the project.

1. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening.

a. Organize door hardware sets in same order as in the Door Hardware Schedule.

2. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.
b. Manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
e. Explanation of abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for door hardware. Supply templates to door and frame manufacturer(s) to enable proper and accurate sizing and locations of cutouts for hardware. Detail conditions requiring custom extended lip strikes, or other special or custom conditions.
g. Door and frame sizes and materials.
h. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.

1) Sequence of Operation: Include description of component functions that occur in the following situations: authorized person wants to enter; authorized person wants to exit; unauthorized person wants to enter; unauthorized person wants to exit.

E. Keying Schedule: Submit keying schedule prepared by or under the supervision of supplier, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificate: Submit certification from the card access control system manufacturer that the installer has been factory trained and certified to install its card reader/locksets.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: Submit maintenance data for each type of door hardware. Include final hardware and keying schedule.

B. Warranties: Submit special warranties specified in this Section.

C. Fire-Rated Door Assembly Testing: Submit a written record of each fire door assembly to the Owner to be made available to the Authority Having Jurisdiction (AHJ) for future building inspections.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Maintenance Tools: Furnish a complete set of specialized tools for Owner's continued adjustment, maintenance, removal, and replacement of door hardware.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Supplier Qualifications: Door hardware supplier, who has completed a minimum of three (3) projects over the last 5 years which were similar in material, design and extent to that indicated for the Project - as determined by the Architect - and which have resulted in construction with a record of successful in service performance, and who is or employs a qualified Architectural Hardware Consultant, available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

1. Electrified Door Hardware Supplier Qualifications: An experienced door hardware supplier who has completed projects with electrified door hardware similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance, and who is acceptable to manufacturer of primary materials.

    a. Engineering Responsibility: Prepare data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

2. Scheduling Responsibility: Preparation of door hardware and keying schedules.

C. Architectural Hardware Consultant Qualifications: A person who is currently certified by the Door and Hardware Institute as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.

1. Electrified Door Hardware Qualifications: Experienced in providing consulting services for electrified door hardware installations.

D. Source Limitations: Obtain each type of door hardware from a single manufacturer, unless otherwise indicated.

E. Regulatory Requirements: Comply with the following:

1. Provide hardware items complying with the applicable provisions for accessibility and usability by the disabled and handicapped in compliance with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)" and ANSI A117.1.
2. NFPA 101: Comply with applicable provisions for means of egress doors.
3. Electrified Door Hardware: Listed and classified by Underwriters Laboratories, Inc. or by a testing agency acceptable to authorities having jurisdiction, as suitable for the purpose indicated.

F. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by Underwriters Laboratories, Inc. for fire ratings indicated, based on testing according to NFPA 252. Provide only door hardware items that are identical to items tested by UL for the types and sizes of doors required. In case of conflict between type of hardware specified and type required for accessibility or fire protection, furnish type required by NFPA and UL. Doors indicated in fire rated partitions and walls shall be positive latching and self-closing, with smoke gaskets where required by applicable codes.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

1.9 COORDINATION

A. Coordinate layout and installation of recessed pivots and closers with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Section 03 30 00 "Cast-in-Place Concrete."

B. Templates: Furnish templates and door hardware schedules, coordinated for the application of door hardware items with door and frame details, to door opening fabricators and trades performing door opening work to permit the preparation of doors and frames to receive the specified door hardware. Where the door hardware item scheduled is not adaptable to the finished size of door opening members requiring door hardware, submit an item having a similar operation and quality to the Architect for review. Each door hardware item shall be fabricated to templates.

C. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to, power supplies, fire alarm system and detection devices, access control system, security system, building control system.

D. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.10 WARRANTY

A. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:

1. Faulty operation of door hardware.
2. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

B. Warranty Period for Electromagnetic Locks: Five years from date of Substantial Completion.

C. Warranty Period for Manual Closers: Ten years from date of Substantial Completion.

D. Warranty Period for Other Hardware: Two years from date of Substantial Completion.

E. Warranty for Mortised Mechanical Lock and Latchsets: Ten years from date of Substantial Completion.

F. Warranty for Heavy Duty Cylindrical Mechanical Lock and Latchsets: Seven years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in this Section, <door hardware sets are keyed to each scheduled door in the door and frame schedule>, and the Door Hardware Schedule.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturer's products.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
3. The hardware supplier shall review each hardware set and compare it with the door types, details, and sizes as shown and verify each hardware item for function, hand, backset, and method of fastening through shop drawing submittals.

2.2 HINGES AND PIVOTS

A. Butt Hinge Products and Manufacturers:

1. Standard Weight, Ball Bearing, 5 Knuckle, Steel: Complying with BHMA A156.1 A8112, one of the following:

    a. BB5000; Bommer Industries, Inc., Landrum, SC (BI).
    b. BB1279; Hager Companies (HAG).
    c. TA2714; McKinney Products Company (MCK).
    d. FBB179; Stanley Commercial Hardware (STH).
    e. 5BB1; Ives (IVS).

2. Heavy Weight, Ball Bearing, 5 Knuckle, Steel: Complying with BHMA A156.1 A8111, one of the following:

    a. BB5004; Bommer Industries, Inc., Landrum, SC (BI).
    b. BB1168; Hager Companies (HAG).
    c. T4A3786; McKinney Products Company (MCK).
    d. FBB168; Stanley Commercial Hardware (STH).
    e. 5BB1HW; Ives (IVS).

3. Heavy Weight, Ball Bearing, 5 Knuckle, Steel, Concealed Electric 24V, 4 Wire: Complying with BHMA A156.1 A8111, one of the following:

    a. BB5064 (ETW04); Bommer Industries, Inc., Landrum, SC (BI).
    b. BB1168 x ETW-4; Hager Companies (HAG).
    c. T4A3786 x CC-4; McKinney Products Company (MCK).
    d. CEFBB168-54; Stanley Commercial Hardware (STH).
    e. 5BB1HW x TW4; Ives (IVS).

4. Standard Weight, Ball Bearing, 5 Knuckle, Steel, Concealed Electric 24V, 4 Wire: Complying with BHMA A156.1 A8112, one of the following:

    a. BB5060 (ETW04); Bommer Industries, Inc., Landrum, SC (BI).
    b. BB1279 x ETW-4; Hager Companies (HAG).
    c. TA2714 x CC-4; McKinney Products Company (MCK).
    d. CEFBB179-54; Stanley Commercial Hardware (STH).
    e. 5BB1 x TW4; Ives (IVS).

B. Pivot and Pivot Hinge Products and Manufacturers:

1. Offset Pivots:

    a. Offset Pivot with Jamb Mounted Bottom Pivot: Mortised mounted, handed, 3/4 inch (19 mm) offset pivot set with sealed bearings for protection against weather and debris and composed of a head mounted top pivot and jamb mounted bottom pivot. Furnish with extended spindles. Complying with BHMA A156.4 C07131 minimum vertical adjustment of 3/16 inch (4.8 mm).

        1) Model 195 Offset Hung Pivot Set; Rixson-Firemark, Inc. (RIX).
        2) 7215 Pivot Set; Ives (IVS).
        3) 0195 Offset Pivot Set; Architectural Builders Hardware Mfg., Inc. (ABH).

    b. Offset Pivot with Floor Mounted Bottom Pivot: Mortised mounted, handed, 3/4 inch (19 mm) offset pivot set with sealed bearings for protection against weather and debris and composed of a head mounted top pivot and floor mounted bottom pivot. Furnish with extended spindles. Complying with BHMA A156.4 C07162.

        1) Model 117 Offset Hung Pivot Set; Rixson-Firemark, Inc. (RIX).
        2) 7226 Pivot Set; Ives (IVS).
        3) 0117 Offset Pivot Set; Architectural Builders Hardware Mfg., Inc. (ABH).

    c. 1/4 inch (6 mm) Offset Pivot with Jamb Mounted Top and Bottom Pivots: Mortised mounted, handed, 1/4 inch (6 mm) offset pivot set composed of a frame mounted top pivot and frame mounted bottom pivot. Complying with BHMA A156.1 A8782.

        1) 327; Stanley Commercial Hardware (STH).
        2) 615; Hager Companies (HAG).

2. Center Pivots: Mortised mounted, non-handed, center pivot set with sealed bearings for protection against weather and debris and composed of a head mounted top pivot and floor mounted bottom pivot. Furnish with extended spindles. Complying with BHMA A156.4 C07032.

    a. Model 370 Center Hung Pivot Set; Rixson-Firemark, Inc. (RIX).
    b. 7255 Pivot Set; Ives (IVS).
    c. 0370 Center Hung Pivot Set; Architectural Builders Hardware Mfg., Inc. (ABH).

3. Electrified Center Pivots: Concealed electric, 3 amp rated for Class II wiring applications, 22 gauge insulated four wire, mortised mounted, non-handed, center pivot set with sealed bearings for protection against weather and debris and composed of a head mounted electric top pivot and floor mounted bottom pivot. Furnish with extended spindles. Complying with BHMA A156.4 C07032 Modified.

    a. Model 370 Center Hung Pivot less standard top pivot x E-H340 Top Pivot; Rixson-Firemark, Inc. (RIX).

4. Intermediate Pivots: Mortised jamb mounted, non-load bearing, handed, 3/4 inch (19 mm) offset intermediate pivots with sealed bearings for protection against weather and debris. Complying with BHMA A156.4 C07321 minimum vertical adjustment of 1/8 inch (3.2 mm).

    a. Model M19 x 3/4 Intermediate Offset Pivots; Rixson-Firemark, Inc. (RIX).
    b. 7200 INT Series Pivots; Ives (IVS).
    c. 019 Intermediate Pivot; Architectural Builders Hardware Mfg., Inc. (ABH).

5. Electrified Intermediate Pivots: Concealed electric, low voltage, minimum 28 gauge insulated four wire, mortised jamb mounted, non-load bearing, handed, 3/4 inch (19 mm) offset intermediate pivots with sealed bearings for protection against weather and debris. Complying with BHMA A156.4 C07321 minimum vertical adjustment of 1/8 inch (3.2 mm).

    a. Model E-M19 x 3/4 Intermediate Offset Pivots; Rixson-Firemark, Inc. (RIX).
    b. 7200PT Series Power Transfer Pivots; Ives (IVS).
    c. E019 Intermediate Pivot; Architectural Builders Hardware Mfg., Inc. (ABH).

C. Invisible Hinges: Full mortised, invisible "Soss" type hinges as manufactured by Universal Industrial Products Company and specifically manufactured for door thickness indicated and fabricated from high strength plated steel, heavy duty zinc alloy castings, and non-removable riveted hinge pins. Each hinge shall be engineered for smooth performance with laminated link construction supplemented by anti-friction materials that reduce friction for smooth, free hinge operation. Complying with BHMA A156.9, B01501.

    1. Hinge Quantity: Provide hinge quantity as recommended by hinge manufacturer based on door width, weight, thickness, door material, and hinge cup selection.

D. General Hinge and Pivot Characteristics: Where door jamb or trim projects to such an extent that the width of leaf specified will not allow the door to clear such frame or trim, furnish hinges and pivots with leaves of sufficient width to clear. Hinges and pivots shall be template hinges conforming to BHMA A156.1 and in accordance with door and frame material requirements.

    1. Pivot Hinge Special Layout: At deep reveals where door frame profiles will not permit the use of a standard top pivot (e.g., deep reveals, narrow frames, full height doors) furnish top pivots less top leaf with specially designed and fabricated pivot block (Rixson Special Layout 102).

2. Pivot Hinge Special Layout: Where door frame and door face profiles are flush and will not permit the use of a standard 3/4 inches (19 mm) offset top pivot furnish top pivots with 1-1/2 inches (38 mm) offset top pivot jamb portion (Rixson Special Layout SP 1124 1-1/2").

E. Butt Hinge and Offset Pivot Hinge Quantity: Provide the following, unless otherwise indicated:

1. Two Hinges: For doors with heights up to and including 60 inches (1524 mm).
2. Three Hinges: For doors with heights of greater than 60 inches (1524 mm) to and including 90 inches (2286 mm).
3. Four Hinges: For doors with heights greater than 90 inches (2286 mm) to and including 120 inches (3048 mm).
4. Provide 4 hinges, plus 1 hinge for every 30 inches (750 mm) of door height greater than 120 inches (3048 mm).

F. Butt Hinge Sizes: 4-1/2 inches (114 mm) high by 4 inches (102 mm) or 4-1/2 inches (114 mm) wide for doors up to and including 36 inches (914 mm) in width; 5 inches (127 mm) high by 4 inches (102 mm) or 4-1/2 inches (114 mm) wide for doors greater than 36 inches (914 mm) in width.

G. Hinge Characteristics: Full mortise type with square corners. All butt hinges are to have non-rising pins for interior hinges and all exterior butt hinges are to be made of non-ferrous base metal and have non-removable pins (NRP). Provide only steel bodied butt and pivot hinges at labeled doors. All butt hinges shall be furnished with button tips. Provide heavy weight, ball bearing, hinges at doors 40 inches (1016 mm) and greater in width.

H. Electrified Functions for Hinges and Pivots: Furnish fully concealed circuit, tamper resistant, wired hinges and pivots at doors requiring power transfer or door monitoring from jamb to door. All electrified hinges and pivots shall be rated for the in-rush amperage of the door mounted device being electrified. Provide each electrified hinge with leads of a length sized to properly tie to door mounted electro-mechanical locking devices.

I. Fasteners: Package all hinges and pivots with machine and wood screws as required by door and frame construction.

2.3 LOCKS AND LATCHES

A. Mortise Lock and Latch Sets: Heavy duty, commercial, mortise bodies complying with BHMA A156.13 Series 1000, Grade 1, with throughbolted lever trim. Furnish mortise type, field reversible without disassembly, field multifunctional without opening lock cases, lock and latch sets with 1 or 2 piece anti-friction deadlocking stainless steel latchbolts having a minimum 3/4 inch (19 mm) throw, 2-3/4 inches (70 mm) backset, and UL listed for 3 hour doors. All lock and latch sets, to be furnished complete with heavy 0.109 inch (2.77 mm) (12 gage)wrought steel zinc dichromate or chrome plated case, trim, adjustable beveled square cornered armored fronts, cold forged steel or stainless steel hubs, and 6 pin cylinders. Conceal fastenings, washers and bushings. Provide wrought, or black plastic, box strikes for each lock and latch set. Provide brass, bronze or stainless steel strikes with curved lips of sufficient length to protect frames. Provide solid forged or cast levers with wrought roses. Where lock functions are scheduled provide non-handed guard bolt and stainless steel deadbolt with a minimum 1 inch (25 mm) throw. Where electro-mechanical locksets are scheduled provide transformers properly sized for conversion of power supply to the power characteristics of the electromechanical locksets. Where electro-mechanical locksets are scheduled provide request to exit (REX) monitoring feature.

1. Sargent 8200 Series, LNJ Design x 130 KB Turnlever; Sargent Manufacturing Company (SGT). Provide handed ANSI 4-7/8 inch curved lip strikes die punched to match bolts provided with latchset functions only, provide non-handed standard curve lip strikes 82-0110 for all other functions. Where electro-mechanical locksets are scheduled provide 8270 Series with trim matching mechanical locksets.
2. Corbin-Russwin ML2000 Series, Lustra LSA Design x 519F10 Thumbturn Lever; Corbin Russwin Architectural Hardware (CR). Provide handed ANSI 4-7/8" curved lip strikes die punched to match bolts provided with latchset functions only 340L62 (RH) and 340L63 (LH), provide handed standard curve lip strikes for all other functions 340L60 (RH) and 340L61 (LH). Where electro-mechanical locksets are scheduled provide ML20900ECL Series with trim matching mechanical locksets.
3. Schlage L9000 Series, 03 Design x A Rose x 09-905 Turnlever; Schlage Lock Company (SCH). Provide handed ANSI 4-7/8 inch curved lip strikes die punched to match bolts provided with latchset functions only (Part No. XL11-820/XL11-821), provide non-handed standard curve lip strikes for all other functions 10-072. Where electro-mechanical locksets are scheduled provide L9000EL Series with trim matching mechanical locksets.
4. Best 45H Series, with 3 Lever Design x H Rose x Thumbturn; Stanley Security Solutions. Provide handed ANSI 4-7/8" curved lip strikes die punched to match bolts provided with latchset functions only S5, provide handed standard curve lip strikes for all other functions S6. Where electro-mechanical locksets are scheduled provide 45HW Series with trim matching mechanical locksets.

B. Bottom Rail Mortised Deadlocks: Heavy duty, commercial, deadlock complying with BHMA A156.5 Type E8211, Grade 1. Furnish bottom rail deadlocks less thumb turn and key cylinders. Where thumb turn, or key, cylinders are scheduled, furnish types as specified for mortise locks fitted with proper cams.

1. MS1861; Adams-Rite Manufacturing Co. (ARM).

C. Narrow Stile Mortised Deadlocks: Heavy duty, commercial, deadlock complying with BHMA A156 Type E8211, Grade 1. Furnish deadlocks less thumb turn and key cylinders. Where thumb turn, or key, cylinders are scheduled, furnish types as specified for mortise locks fitted with proper cams.

1. MS1850S Series x 4001 Box Strike; Adams-Rite Manufacturing Co. (ARM).

D. Padlocks: Minimum 11/32 inch diameter hardened steel shackle with multiple plating for wear and corrosion resistance, case shall be machined from solid extruded brass, height of opening shall be minimum 2-9/16 inch (65 mm). Housing shall be machined for 6 pin core.

1. 758; Sargent Manufacturing Company (SGT).
2. PL5000 Series; Corbin Russwin Architectural Hardware (CR).
3. PL1000 Series; Schlage Lock Company (SCH).
4. B Series; Stanley Security Solutions.

E. Rabbeted Doors: Provide special rabbeted front and strike on locksets for rabbeted meeting stiles.

2.4 ELECTROMAGNETIC LOCKS

A. Exposed, Surface Applied Type: Surface mount application with a minimum 1500 pound holding force at 24 V, provide complete with all cabling, rectifier kits, holding force sensors, adjustable time delay, and mounting hardware, complying with BHMA A156.23, Grade 1, high security, fail-safe operation.

1. M490P; Schlage Electronics (SCH).
2. 1511 EmLock; Security Door Controls (SDC).
3. Magnalock M82 Series; Securitron (SEC).

B. Concealed, Shear Type: Top mount application with a minimum 1000 pound holding force at 24 V, vertical armature adjustment thru edge of door, provide complete with all cabling, rectifier kits, holding force sensor, and mounting hardware, complying with BHMA A156.23, Grade 2, medium security, fail-safe operation.

1. GF3000TRD; Schlage Electronics (SCH).
2. 1562-HTR Micro/Shear EmLock; Security Door Controls (SDC).
3. Shear Aligning Magnalock (SAM); Securitron (SEC).

2.5 CYLINDERS AND KEYING

A. Cores for Bored Cylindrical Locksets: Provide key-in lever 6 pin cores for all bored cylindrical locksets, keyed into building system, as manufactured by the bored lockset manufacturer.

B. Cylinders: Full faced cylinders with square shouldered (not tapered) compression rings, 6 pin cylinders, standard threaded, keyed into building system, with cams to suit lock functions. Provide cylinders for installation into all locks.

1. 1100 Series Flexible Head Mortise Cylinder; Corbin Russwin Architectural Hardware (CR).
2. Series 40 Adjustable Front Cylinder; Sargent Manufacturing Company (SGT).
3. 30-001 full-faced mortised cylinder with 36-083 compression rings; Schlage Lock Company (SCH)..
4. 1E Series with Straight Rings ; Stanley Security Solutions.

C. Key Control Systems:

1. Model 1205-C; Lund Equipment Co., Inc.
2. Aristocrat AWC 450-S; Telkee, Inc.

D. Keying System: Final keying to determine lock cylinders, keyed alike sets, level of keying, master key groups, grandmaster keying system shall be as directed by the Owner. Supplier and Contractor shall meet with the Owner and obtain final instructions in writing. Provide two nickel silver keys for each lock, and six keys for each grandmaster and masterkey system. Provide two blank keys for each lock for the Owner's convenience in making additional keys.

1. Construction Keyed Cylinders: Provide construction keyed cylinders in locks during construction and as may be necessary for security or as may be requested by the Owner. Upon completion of the construction phase, construction keyed cylinders shall be voided mechanically without the removal of the cylinders from the locks. All construction keyed cylinders shall be individually keyed as required and subject to a single master key.

E. Key Control System: Furnish a key control system of the type specified. Furnish complete accessories including key gathering envelopes, labels, reserve pattern key tags with self-locking key clips, key receipt forms, key receipt holders, 3-way visible card index, temporary key markers and permanent key markers.

2.6 STRIKES

A. Strikes for Locks and Latches: All strikes for locks and latches shall be provided by the lock and latch manufacturer unless otherwise specified or scheduled, refer to Article 'Locks and Latches.'

B. Dustproof Floor Strikes: Complying with BHMA A156.16, Type L04251, L04021 or L14021, one of the following:

1. No. 80; Door Controls International.
2. DP2; Ives.
3. 3910; Trimco Hardware (TBM).
4. 570; Rockwood Manufacturing Company (RM).

C. Dustproof Threshold Strikes: Complying with BHMA A156.16, Type L2402X or L14011, one of the following:

1. No. 81; Door Controls International.
2. DP1; Ives.
3. 3910N; Trimco Hardware (TBM).
4. 570 less plate; Rockwood Manufacturing Company (RM).

2.7 OPERATING TRIM (PUSHES AND PULLS)

A. Type 1: Fabricate push pulls for back to back mounting from 1-1/2 inch (38 mm) diameter stainless steel bar stock in finish as scheduled. Custom fabricate push pulls to length indicated with minimum 2-11/16 inch (68 mm) projection, minimum 1-1/2 inch (38 mm) clearance. Furnish spacers threaded to accept concealed throughbolt attachment including provision for spanner tightening of bolts of assembly. Do not provide baseplates at stile to pull interface.

1. T51-01-023; Elmes.

B. Type 2: Fabricate offset push pulls for back to back mounting from 1 inch (25 mm) diameter stainless steel bar stock in finish as scheduled. Custom fabricate pulls with minimum 3-1/4 inch (83 mm) projection, 2-1/4 inch (57 mm) clearance, minimum 4 inch (102 mm) offset, 10 inch (245 mm) center to center of bases with center line of pull centered on door stiles. Furnish spanner turning washer and stud assemblies threaded to accept concealed throughbolt attachment including provision for spanner tightening of bolts of push/pull assembly. Do not provide baseplates at stile to pull interface. Provide one of the following:

1. 1191-3; Trimco Hardware (TBM).
2. BF157; Rockwood Manufacturing Company (RM).

C. Type 3: Fabricate push pulls for back to back mounting from 1 inch (25 mm) diameter stainless steel bar or tube stock in finish as scheduled. Custom fabricate push pulls to length indicated with minimum 3 inch (76 mm) projection, minimum 2 inch (51 mm) clearance with bases centered on door stiles. Furnish spacers threaded to accept concealed throughbolt attachment including provision for spanner tightening of bolts of assembly. Do not provide baseplates at stile to pull interface.

1. RM3300 with straight intermediate post; Rockwood Manufacturing Company (RM).

D. Type 6: Fabricate straight push pulls for back to back mounting from 1 inch (25 mm) diameter stainless steel bar stock in finish as scheduled. Custom fabricate pulls with minimum 2-1/2 inch (63.5 mm) projection, minimum 1-1/2 inch (38 mm) clearance, 10 inch (245 mm) center to center of bases with center line of pull centered on door stiles. Furnish spanner turning washer and stud assemblies threaded to accept concealed throughbolt attachment including provision for spanner tightening of bolts of push/pull assembly. Do not provide baseplates at stile to pull interface. Provide one of the following:

1. 1195-2; Trimco Hardware (TBM).
2. 111; Rockwood Manufacturing Company (RM).

3. 8103-0; Ives.

2.8 ACCESSORIES FOR PAIRS OF DOORS

A. Tubular Coordinators and Filler Bars: UL listed for use on labeled doors and complying with BHMA A156.3, Type 21A. Provide with filler piece of length as required to close the header area and mounting brackets at stop mounted hardware. Furnish extenders at active leaf levers where required to clear overlapping astragals on doors installed with pocket pivot hinges or jambs with deep jamb stops.

1. No. 600 Series x Filler Bar; Door Controls International (DCI).
2. COR Series Coordinators x FL filler; Ives (IVS).
3. 1600 Series x FB Series Filler Bar; Rockwood Manufacturing Company (RM).

B. Coordinator Brackets: UL listed for use on labeled doors and complying with BHMA A156.3, Type 21B. Minimum 7 inch (178 mm) projection.

1. No. 500 Coordinator; Door Controls International (DCI).
2. CORG7; Ives (IVS).
3. 576; Rockwood Manufacturing Company (RM).

C. Carry Open Bars: UL listed for use on labeled doors and complying with BHMA A156.3, Type 21. Provide carry-open bars for inactive leaves of pairs of doors, unless automatic or self-latching bolts are used.

1. No. CB Carry Bar; Door Controls International (DCI).
2. CB1 Carry Bar; Ives (IVS).
3. 1100; Rockwood Manufacturing Company (RM).

D. Astragals: UL listed for use on labeled doors, surface applied continuous extruded aluminum minimum 7/8 inch wide retaining EPDM gaskets for installation on both sides of all meeting stiles of doors:

1. 125NA; National Guard Products, Inc. (NGP).
2. 305CN; Pemko Manufacturing Co., Inc. (PEM).

E. Lock Protectors: Fabricated from heavy gauge metal and in finish as scheduled. Furnish protectors sized to cover the latch bolt area of the door and lock and narrow enough to clear rose and escutcheon lock trims, offset formed to clear strike projection. Machine lock protectors where required to accommodate rose and escutcheon trims, and cylinders.

1. LG Series Lock Guards; Ives (IVS).
2. Latch Guard 320; Rockwood Manufacturing Company (RM).

2.9 CLOSERS

A. Surface-Mounted Closers with Track Arms: Closers shall be certified by ETL laboratories and the manufacturer to a minimum of 8,000,000 cycles and meet BHMA A156.4, Grade 1. Closers used in conjunction with overhead stops and holders shall be templated and coordinated to function properly. Properly detail closers to meet application requirements by providing drop plates, brackets, etc. to meet application and installation requirements as indicated. Comply with manufacturer's recommendations for size of door closer depending on size of door, stack pressure conditions, exposure to weather, and anticipated frequency of use. Closers shall have adjustable spring power, full rack and pinion, independent closing speed and latch regulating V-slotted valves, fully hydraulic with a high strength cast iron cylinder and solid forged steel arms, bore diameter of 1-1/2 inches (38.1 mm), pinion shaft diameter of 5/8 inches (15.87 mm), adjustable back check, cushion and built-in stop feature where scheduled, hold open arms where scheduled, delayed action where scheduled, arm finish to match closer cover finish scheduled. Provide metal covers of clean line design with plated or primed for paint finish as scheduled and that require removal in order to make adjustments to closer.

1. 4011T; LCN Closers (LCN).
2. 281 with Track Arm; Sargent Manufacturing Company (SGT).

B. Surface-Mounted Closers Without Track Arms: Closers shall be certified by ETL laboratories and the manufacturer to a minimum of 8,000,000 cycles and meet BHMA A156.4, Grade 1. Closers used in conjunction with overhead stops and holders shall be templated and coordinated to function properly. Properly detail closers to meet application requirements by providing drop plates, brackets, etc. to meet application and installation requirements as indicated. Comply with manufacturer's recommendations for size of door closer depending on size of door, stack pressure conditions, exposure to weather, and anticipated frequency of use. Closers shall have adjustable spring power, full rack and pinion, independent closing speed and latch regulating V-slotted valves, fully hydraulic with a high strength cast iron cylinder and solid forged steel arms, bore diameter of 1-1/2 inches (38.1 mm), pinion shaft diameter of 5/8 inches (15.87 mm), adjustable back check, cushion and built-in stop feature where scheduled, hold open arms where scheduled, delayed action where scheduled, arm finish to match closer cover finish scheduled. Provide metal covers of clean line design with plated or primed for paint finish as scheduled and that require removal in order to make adjustments to closer.

1. 4110/4010; LCN Closers (LCN).
2. 281; Sargent Manufacturing Company (SGT).

C. Overhead Concealed Closers, Butt and Offset Hung: Closers shall meet BHMA A156.4, Grade 1. Properly detail closers to meet application and installation requirements as indicated. Comply with manufacturer's recommendations for size of door closer depending on size of door, stack pressure conditions, and anticipated frequency of use. Provide manufacturer's standard cover plate finished to match exposed portions of butts or pivots provided.

1. 2010/2030; LCN Closers (LCN).
2. RTS 88-BI Series, Offset Slide Arm, barrier free function; Dorma.

D. Overhead Concealed Closers, Center Hung: Closers shall meet BHMA A156.4, Grade 1. Properly detail closers to meet application and installation requirements as indicated. Comply with manufacturer's recommendations for size of door closer depending on size of door, stack pressure conditions, and anticipated frequency of use. Provide manufacturer's standard cover plate finished to match exposed portions of pivots provided. Provide with manufacturer's standard top arm and pivot to suit conditions indicated.

1. 6030; LCN Closers (LCN).
2. RTS 88-BI Series, End Loaded Arm, barrier free function; Dorma.

E. Electromagnetic Overhead Surface Closers: Closers shall meet BHMA A156.15 and NFPA 101. Properly detail closers to meet application requirements by providing drop plates, brackets, etc. to meet application and installation requirements as indicated. Comply with manufacturer's recommendations for size of door closer depending on size of door, stack pressure conditions, and anticipated frequency of use. Arm and track finish to match closer cover finish scheduled. Provide metal covers of clean line design with plated or primed for paint finish as scheduled and that require removal in order to make adjustments to closer. Furnish closers for 24 V AC/DC voltage.

1. Sentronic 4040SE; LCN Closers (LCN).

2.10 PROTECTIVE TRIM UNITS

A. Kick and Armor Plates: Fabricate protection plates from minimum 0.050 inch (1.3 mm) thick stainless steel, beveled top and 2 sides (B3E), square corners, complying with BHMA A156.6, and fastened with oval head Phillips fasteners countersunk into plate surface.

1. Series 8400; Ives (IVS).
2. K1050 Doorplate Series; Rockwood Manufacturing Company (RM).
3. KA050-2 Armor Plate and KOO50 for Kickplates; Trimco Hardware (TBM).

B. Size: Furnish kick and armor plates sized 2 inches (51 mm) less than door width when located on push side of door and 1 inch (24.5 mm) less than door width when indicated on the pull side of door. Furnish kickplates 12 inches (305 mm) high, furnish armor plates 48 inches (1219 mm) high unless otherwise indicated. Provide protective plates with cutouts for locks, louvers and windows to the extent indicated. Mount protective plates flush with bottom of door.

2.11 STOPS AND HOLDERS

A. Angle Stops: Special angle stop, fabricated from brass or bronze, for single or pairs of doors without stops and having either a single continuous formed sponge silencer or a minimum of two rubber silencers per stop, minimum 1-1/2 inches (38 mm) wide by 3 inches (76 mm) long base for mortising into the head of door frame, minimum 3/4 inch (19 mm) maximum stop face projection; finish as scheduled.

1. AS18 Angle Stop; Ives (IVS).
2. 489; Rockwood Manufacturing Company, Inc. (RM).

3. 1801 Angle Stop; Architectural Builders Hardware Mfg., Inc. (ABH).

B. Roller Latch Angle Stops: Special angle stop BHMA A156.16 Type E19111, fabricated from brass or bronze, for single doors without stops and having a minimum of two rubber silencers per stop, minimum 1-1/2 inches (38 mm) wide by 4-1/2 inches (114 mm) long base for mortising into the head of door frame, 9/16 inch (14 mm) maximum stop face projection, adjustable roller latch and ramp roller strike; finish as scheduled.

1. 4040 Adjustable Roller Latch; Door Controls International (DCI).
2. RL1152; Ives (IVS).
3. 593; Rockwood Manufacturing Company (RM).
4. 1559BL; Trimco Hardware (TBM).

C. Roller Latches: Special roller latch complying with BHMA A156.16 Type E19101, fabricated from brass or bronze, for single doors, minimum 1 inch (25 mm) wide by 3-3/8 inches (86 mm) long base for mortising into the head door frame, adjustable nylon covered roller latch and ramp roller strike; finish as scheduled.

1. 4030 Adjustable Roller Latch; Door Controls International (DCI).
2. RL30; Ives (IVS).
3. 590; Rockwood Manufacturing Company (RM).
4. 1559WA; Trimco Hardware (TBM).

D. Ball Type Latches: 4 way adjustable ball catch complying with BHMA A156.9 Type B13292, fabricated from brass or bronze, for single doors, with two adjustable stainless steel balls held under adjustable spring tension and hook strike.

1. CL21A; Ives (IVS).

E. Concealed Overhead Door Holders: Heavy duty, concealed mounting, full mortised, bronze bodied, slide track design, with heavy shock absorber spring providing 5 to 7 degree compression before deadstop, non-metal slide and shock blocks, 110 degree maximum opening, complying with BHMA A156.8 Type C11511 for hold open and Type C11541 for stop function. Provide stop, or hold open, functions as scheduled.

1. 1000 Series; Architectural Builders Hardware Mfg., Inc. (ABH).
2. 100 Series; Glynn-Johnson (GJ).
3. Checkmate Heavy Duty 1 Series; Rixson-Firemark, Inc. (RIX).

F. Exposed Overhead Door Holders: Heavy duty, surface mounted, bronze bodied, slide track design, with heavy shock absorber spring providing 5 to 7 degree compression before deadstop, non-metal slide and shock blocks, 110 degree maximum opening, complying with BHMA A156.8 Type C12511 for hold open and Type C12541 for stop function. Provide stop, or hold open, functions as scheduled.

1. 9000 Series; Architectural Builders Hardware Mfg., Inc. (ABH).
2. 90 Series; Glynn-Johnson (GJ).
3. Checkmate Heavy Duty 9 Series; Rixson-Firemark, Inc. (RIX).

G. Electromagnetic Door Hold Opens for Labeled Fire and Smoke Door Assemblies: Provide each electromagnetic door hold open with fail-safe operation, concealed wiring, door mounted contact plates with concealed mounting fasteners, shims, extensions, and installed approximately 6 inches in from lock edge of door. Comply with BHMA A156.15 for wall mounted single unit, water resistant floor mounted single unit, water resistant floor mounted double unit for back to back mounting to the extent indicated. Coordinate voltage and current characteristics with power supplied to holders, in addition coordinate with fire detectors and interface with fire alarm system.

1. Wall Mounted Single Unit - Low Profile:

    a. Model 989; Rixson-Firemark, Inc. (RIX).
    b. Model 2400L; Architectural Builders Hardware Mfg., Inc. (ABH).

2. Wall Mounted Single Unit - High Profile: Provide door holder assemblies with a total projection to clear hardware and trim projections.

    a. Model 990M Series; Rixson-Firemark, Inc. (RIX).
    b. Model 2400; Architectural Builders Hardware Mfg., Inc. (ABH).

3. Water Resistant Floor Mounted Unit:

    a. Model 980; Rixson-Firemark, Inc. (RIX).
    b. Model 2600; Architectural Builders Hardware Mfg., Inc. (ABH).

4. Water Resistant Floor Mounted Double Unit for Back to Back Mounting:

    a. Model 981; Rixson-Firemark, Inc. (RIX).
    b. Model 2700; Architectural Builders Hardware Mfg., Inc. (ABH).

H. Floor Stops: Cast half dome design with rubber bumper, finish as scheduled. Provide manufacturer's standard riser heights as required for carpeted areas in conjunction with the floor bumpers scheduled. Unless otherwise scheduled, provide floor stops at each door leaf where partition construction does not allow the door to swing greater than 90 degrees.

1. For Thresholds, Carpet and/or Undercut Doors: Comply with BHMA 156.16 Type L12161, L02161 or L12141.

    a. 3320X; Door Controls International (DCI).
    b. FS438; Ives (IVS).
    c. 1211; Trimco Hardware (TBM).
    d. 443; Rockwood Manufacturing Company (RM).

2. For Doors with Standard 3/8 inch (9.5 mm) Clearance: Comply with BHMA 156.16 Type L12161, L02141 or L12141.

    a. 3310X; Door Controls International (DCI).
    b. FS436; Ives (IVS).
    c. 1211; Trimco Hardware (TBM).

d. 441; Rockwood Manufacturing Company (RM).

I. Silencers for Metal Door Frames: BHMA A156.16, Type L03011; grey rubber, minimum diameter 1/2 inch (13 mm); fabricated for drilled-in application to frame, specifically designed to form an air pocket to absorb shock and reduce noise of door closing. Provide two silencers for each pair of doors, three silencers for each single door.

1. 8S; Door Controls International (DCI).
2. SR64; H. B. Ives (IVS).
3. 1229A; Trimco Hardware (TBM).
4. 608; Rockwood Manufacturing Company (RM).

J. Silencers for Aluminum Door Frames: Refer to Section 08 12 16 "Interior Aluminum Doors and Frames."

K. Wall Stops: Cast disc type with concave rubber bumper, having a minimum 2-1/8 inch (54 mm) diameter base with nominal 1 inch (25 mm) projection and concealed attachment to substrate. Unless otherwise scheduled, provide wall stops at each door leaf where partition construction does not allow the door to swing greater than 90 degrees.

1. For Attachment to Masonry: Complying with BHMA A156.16, Type L12251 or L12101.

   a. WS401CCV; H.B. Ives (IVS).
   b. 1270CV; Trimco Hardware (TBM).
   c. 404; Rockwood Manufacturing Company (RM).

2. For Attachment to Gypsum Wallboard: Complying with BHMA A156.16, Type L12251 or L12101.

   a. WS402CCV; H.B. Ives (IVS).
   b. 1270WV; Trimco Hardware (TBM).
   c. 403; Rockwood Manufacturing Company (RM).

L. Magnetic Catches: Aluminum bodied extra heavy duty magnetic catch with outside dimensions of approximately 13/16 by 3-1/8 by 1 inch (20.63 by 79.37 by 25 mm) complying with BHMA A156.9, Type B03161 fabricated with self aligning magnets and furnished complete with door strikes.

1. 327; H.B. Ives (IVS).
2. 901; Rockwood Manufacturing Company (RM).
3. CD45 Double Magnetic Cabinet Catch; Stanley Commercial Hardware (STH).

2.12 DOOR GASKETING

A. Type 1: Self adhesive flexible silicone type, continuous gaskets for installation at all heads and jambs of doors:

1. 5050C; National Guard Products, Inc. (NGP).

2. S88BL; Pemko Manufacturing Co., Inc. (PEM).
3. 188BK; Zero International, Inc. (ZRO).

B. Type 2: Self adhesive flexible silicone type, continuous gaskets for installation at all heads and jambs of doors, extruded aluminum automatic door bottoms with two lines of flexible, silicone type, continuous gaskets for mortised installation at door bottoms.

1. 5050C x 320S automatic door bottom; National Guard Products, Inc. (NGP).
2. S88BL x 420ASL automatic door bottom; Pemko Manufacturing Co., Inc. (PEM).

C. Type 3: Continuous extruded aluminum housing 1-3/8 by 3/4 inch (35 by 19.05 mm) retaining closed cell sponge neoprene gasket and snap on cover to conceal fasteners; finish as scheduled. Zero 470A modified.

D. Type 4: Continuous door bottom aluminum extrusion with continuous nylon brush pile sweep; sweep shall be field cut to length required to have positive contact with threshold without binding door.

1. 90137CP; Pemko.
2. C390MIL; Sealeze.

E. Type 5: Self adhesive flexible silicone type, continuous gaskets for installation at all heads and jambs of doors, extruded aluminum automatic door bottoms with one line of flexible, santoprene or silicone type, continuous gaskets for surface applied installation at door bottoms.

1. 5050C x 220SA automatic door bottom; National Guard Products, Inc. (NGP).
2. S88BL x 412CSL automatic door bottom; Pemko Manufacturing Co., Inc. (PEM).

F. Type 6: Provide the following on the scheduled paired exterior door openings:

1. Head and Jamb Gaskets: Self adhesive flexible silicone type, continuous gaskets for installation at all heads and jambs of each door leaf in the door opening.

   a. 5050W; National Guard Products, Inc. (NGP).
   b. S88W; Pemko Manufacturing Co., Inc. (PEM).
   c. 188SWH; Zero International, Inc. (ZRO).

2. Meeting Stile Gasket: Paired set of gaskets which are continuous surface lock edge applied, extruded aluminum type, retaining replaceable nylon brush gasketing; brush shall be field butted, not overlapped; finish as scheduled.

   a. 8192A; Zero International, Inc. (ZRO).
   b. 18061CP; Pemko Manufacturing Co., Inc. (PEM).
   c. 802S Astragals/Meeting Stiles; Hager Companies (HAG).

2.13 THRESHOLDS

A. Type 1: 1/2 inch (13 mm) high by 5 inches (127 mm) wide extruded aluminum double beveled saddle threshold.

1. 412SA; Hager Companies (HAG).
2. 171A; Pemko Manufacturing Co., Inc. (PEM).
3. S205A; Reese Enterprises, Inc. (RE).
4. 655A; Zero International, Inc. (ZRO).

B. Type 2: 1/2 inch (13 mm) high by minimum 4 inches (102 mm) wide extruded aluminum half saddle threshold with offset to receive carpet finish.

1. 431S; Hager Companies (HAG).
2. 324; National Guard Products, Inc. (NGP).
3. 227A; Pemko Manufacturing Co., Inc. (PEM).

C. Type 3: 1/2 inch (13 mm) high by 5 inch (127 mm) wide extruded aluminum panic threshold with resilient bumper gasket.

1. 477S; Hager Companies (HAG).
2. 950; National Guard Products, Inc. (NGP).
3. S257AV; Reese Enterprises, Inc. (RE).
4. 566A; Zero International, Inc. (ZRO).

D. Type 4: Minimum 4-1/2 inches (114 mm) wide, interlocking, water return type, extruded aluminum threshold with drain pan.

1. 608S; Hager Companies (HAG).
2. 145A; Pemko Manufacturing Co., Inc. (PEM).
3. 175A; Zero International, Inc. (ZRO).

E. Type 5: 7/16 inch (11 mm) high by minimum 1-3/4 inches (45 mm) wide extruded aluminum carpet threshold.

1. 505SA; Hager Companies (HAG).
2. 236A; Pemko Manufacturing Co., Inc. (PEM).
3. 1682A; Zero International, Inc. (ZRO).

F. Type 6: 7/8 inch (22 mm) high by minimum 4-7/8 inches (123 mm) wide extruded aluminum threshold with resilient rubber gasket.

1. 580S; Hager Companies (HAG).
2. 277AS; Pemko Manufacturing Co., Inc. (PEM).
3. 565A; Zero International, Inc. (ZRO).

G. Type 7: 1/2 inch (13 mm) high by 9-3/4 inches (248 mm) wide extruded aluminum double beveled saddle threshold, with mitered returns, and notched to receive pivot hinge unless otherwise scheduled.

1. 653S x custom width; Hager Companies (HAG).
2. Type 13 Saddle x custom width; Pemko Manufacturing Co., Inc. (PEM).
3. Type 3 x 9-3/4 inch Wide Aluminum Threshold with Mitered Returns; Rixson-Firemark, Inc. (RIX).

2.14 SLIDING DOOR HARDWARE

A. Sliding Door Hardware: Provide complete sets consisting of continuous ball bearing hanger tracks, door hangers with provision for horizontal and vertical adjustments, floor guide, supports, track mounted stops, and rated for a door weight of 1000 pounds (454 kg).

1. Top Line Grant 5300; Hettich International.

2.15 MISCELLANEOUS DOOR HARDWARE

A. Boxed Power Supplies: Provide modular units complying with NEMA ICS 6, electrified for Type 4 enclosure; filtered and regulated; voltage rating and type matching requirements of door hardware served; and listed and labeled for use with fire alarm systems.

B. Coat Hooks: Double coat hook, cast brass bodied, minimum 1-1/8 by 1-1/8 by 1-1/8 inch (28.6 by 28.6 by 28.6 mm) projection.

1. 582 Double Coat Hook; H.B. Ives (IVS).
2. Small Double Coat Hook No. 796; Rockwood Manufacturing Company (RM).

2.16 FABRICATION

A. Manufacturer's Nameplate: Provide each door hardware item without exposed manufacturers' labels, names, or designs.

B. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended. Provide Phillips oval-head screws with finished heads to match surface of door hardware item being attached. Machine screws and expansion shields shall be used for attaching hardware to concrete and masonry. Use throughbolts for renovation work only where existing door blocking and reinforcements are unknown.

1. Concealed Fasteners: All new doors and door frames have been specified with adequate blocking and reinforcement provisions to eliminate exposed throughbolting of hardware items. Doors installed with exposed throughbolts will be rejected and replaced by the Contractor at no cost to the Owner. Where through bolts are used on existing doors provide sleeves for each through bolt.

2.17 FINISHES

A. Standard: Comply with BHMA A156.18.

B. Appearance of Finished Work: Finishes of the same designation, that come from two or more sources, shall match when the items are viewed at arm's length and approximately 24 inches (610 mm) apart. Unless otherwise scheduled, match each hardware item in a single hardware set with the scheduled latch or lock set finish. Painting of BHMA 600 (USP) surfaces is required and is specified under Section 09 91 23 "Interior Painting."

C. Designations: The abbreviations used to schedule hardware finishes are generally BHMA (Federal Standards where indicated in parenthesis) designations. Comply with base material and finish requirements indicated by the following:

1. BHMA 600 (USP): Primed for painting.
2. BHMA 605 (US3): Bright brass, clear coated.
3. BHMA 606 (US4): Satin brass, clear coated.
4. BHMA 611 (US9): Bright bronze, clear coated.
5. BHMA 612 (US10): Satin bronze, clear coated.
6. BHMA 613 (US10B): Dark-oxidized satin bronze, oil rubbed.
7. BHMA 618 (US14): Bright nickel plated, clear coated.
8. BHMA 619 (US15): Satin nickel plated, clear coated.
9. BHMA 622:(US19): Flat black coated.
10. BHMA 625 (US26): Bright chromium plated.
11. BHMA 626 (US26D): Satin chromium plated.
12. BHMA 628 (US28): Satin aluminum, clear anodized.
13. BHMA 629 (US32): Bright stainless steel.
14. BHMA 630 (US32D): Satin stainless steel.
15. BHMA 689 (US28): Aluminum painted.
16. Alum.: Aluminum.

PART 3 - EXECUTION

3.1 PREPARATION

A. Hardware for fire door assemblies shall be installed in accordance with NFPA 80. Hardware for smoke and draft control door assemblies shall be installed in accordance with NFPA 105. Install hardware for non-labeled and non-smoke and draft door assemblies in accordance with BHMA A156.115for steel doors and frames, and BHMA A156.115-W series for wood doors, and hardware manufacturer's installation instructions for doors and frames fabricated from other than steel or wood.

1. All modifications to fire doors and frame for electric and mortised hardware shall be made by the respective door and frame manufacturers.

B. Smoke Seals at S Labeled Door Assemblies: Provide and install smoke seals at S labeled doors in accordance with door manufacturer's instructions.

3.2 INSTALLATION

A. Mounting Heights: Mount door hardware units at the following heights, unless specifically indicated on the Drawings or required to comply with governing regulations:

1. Locks and Latches: 38 inches (956 mm) to center of lever from finish floor.
2. Door Pulls: 44 inches (1118 mm) from finish floor to center of grip. Pull bases centered on door stiles, unless otherwise indicated.
3. Push Plates: 44 inches (1118 mm) from finish floor to center of plate. Coordinate with pull location.
4. Horizontal Push/Pull Bar: 42 inches (1067 mm) from finish floor to center of pull/pull. Push/Pull bases centered on door stiles, unless otherwise indicated.
5. Butt Hinges: 10 inches (254 mm) to bottom of lowest hinge from finish floor; 5 inches (127 mm) to top of upper hinge from top of door; space intermediate hinges equally between lower and upper hinges.
6. Deadbolts: Not more than 44 inches (1118 mm) from finish floor to operating trim.
7. Coat Hooks: 48 inches (1200 mm) from finish floor to center of coat hook.

B. Install each door hardware item to comply with manufacturer's written instructions. Install overhead surface closers for maximum degree of opening obtainable. Place on room side of corridor doors, stair side of stair doors, secondary corridor side of doors between corridors. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be finished, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. All wall stops shall be installed with reinforced blocking in wallboard construction. Drywall anchors are not an acceptable means of reinforcement/blocking. Provide intermediate steel plates or channel reinforcement backing at wall stops mounted in wallboard construction.

C. Do not install permanent key cylinders in locks until the time of preliminary acceptance by the Owner. At the time of preliminary acceptance, and in the presence of the Owner's representative, permanent key all lock cylinders. Record and file all keys in the key control system specified, and turn system over to Owner for sole possession and control.

D. Key control storage system shall be installed where directed by the Owner.

E. Thresholds: Thresholds shall be secured with a minimum of 3 fasteners per single door width and 6 fasteners per double door width with a maximum spacing of 12 inches (305 mm). Minimum screw size shall be No. 10 length, dependent on job conditions, with a minimum of 3/4 inch (19 mm) thread engagement into the floor or anchoring device used. Screw heads to be countersunk and flush with face of threshold. Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Section 07 92 00 "Joint Sealants." Once installed thresholds shall not rock or cause noise when walked on.

3.3 FIELD QUALITY CONTROL

A. Independent Architectural Hardware Consultant: Owner will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.4 ADJUSTING

A. Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every hardware component. Replace hardware components that cannot be adjusted to operate as intended. Adjust door control devices to compensate for building stack pressures, final operation of forced air mechanical equipment and to comply with referenced accessibility requirements.

1. Test each electrical hardware item to determine if devices are properly functioning. Wiring shall be tested for correct voltage, current carrying capacity, and proper grounding. Stray voltages in wiring shall be eliminated.
2. Coordinate with electrical installation for interface and connection with life safety and security systems.

B. Fire-Rated Door Assembly Testing: Upon completion of the installation, test each fire door assembly in the project to confirm proper operation of its closing device and that it meets all criteria of a fire door assembly as per NFPA 80 2007 Edition. The inspection of the fire doors is to be performed by individuals with knowledge and understanding of the operation components of the type of door being subjected to testing and who are either credentialed as an Architectural Hardware Consultant (AHC) or as a Fire Door Annual Inspector (FDAI). A written record shall be maintained and transmitted to the Owner to be made available to the Authority Having Jurisdiction (AHJ). The record shall list each fire door assembly throughout the project, and include each door number, an itemized list of hardware set components at each door opening, and each door location in the facility.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation. Clean hardware components as necessary to restore proper finish. Provide protection during the progress of the work and maintain conditions that ensure door hardware is in perfect working order and without damage or deterioration at time of Substantial Completion.

END OF SECTION 08 71 00

HARDWARE GROUP NO. 01

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	CB1900R 5 X 4.5	652	STANLEY
1	EA	CLASSROOM LOCK	7KC-3-7-R-14-D-STK-626	626	BEST
1	EA	SURFACE CLOSER	D-3551-EDA-689-SN	689	STANLEY
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVES

HARDWARE GROUP NO. 02

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	CB1900R 5 X 4.5	652	STANLEY
1	EA	STOREROOM LOCK	7KC-3-7-D-14-D-STK-626	626	BEST
1	EA	SURFACE CLOSER	D-3551-EDA-689-SN	689	STANLEY
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVES

HARDWARE GROUP NO. 03

Provide each Sliding door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	THUMB TURN LOCK	Accurate 2001-SDL3	626	DOOR MANUFACTURER
1	EA	PULL HANDLE	1-1/4” X 24” STRAIGHT	630	DOOR MANUFACTURER

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Doors.
2. Interior borrowed lites.

1.2 ACTION SUBMITTALS

A. Product Data: Submit product data for each glass product and glazing material indicated.

B. Samples: Label samples to indicate product, characteristics, and locations in the Work. Furnish samples of the following:

1. Except for clear glass, submit samples of each glass type specified, in the form of 12 inch (300 mm) square Samples.
2. Submit samples of each glass type specified where production run variations and defects are expected.
3. Submit samples of applied film adhered to clear glass, in the form of 12 inch (300 mm) square samples.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates: Submit a letter from glass manufacturer certifying that he has reviewed the glazing details proposed for the Project, including the use of gaskets and sealants, and that each product to be furnished is recommended for the application shown.

B. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

1. Material Certificates: Submit glass treatment certificates signed by manufacturer of the heat-soaked glass products certifying that products furnished comply with requirements.

C. Product Test Reports: Submit product test reports for each type of glazing sealant and gasket indicated.

D. Warranties: Submit special warranties specified in this Section.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Deliver in manufacturer's containers suitable for storing, clearly labeled as to type, size, and thickness. Include manufacturer's instructions for care and storage of glass. Store on the premises where directed.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for Project and whose work has resulted in construction with a record of successful in-service performance.

B. Source Limitations for Glass and Glazing Accessories: Obtain glass and glazing accessories from one source for each product indicated below:

1. Primary glass.
2. Coated glass.
3. Heat-treated glass, including heat-strengthened, tempered, and heat-soaked glass.
4. Laminated glass.
5. Glazing gaskets.

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

D. Safety Glass: Comply with the applicable requirements of the laws, codes, ordinances and regulations of Federal and Municipal authorities having jurisdiction. Wherever requirements conflict, the more stringent shall be required. Obtain approvals from all such authorities. As a minimum, provide Category II materials complying with testing requirements in 16 CFR 1201 (Consumer Product Safety Commission "Safety Standard for Architectural Glazing Materials," as published in the Code of Federal Regulations) and ANSI Z97.1 for Category A performance.

1. Subject to compliance with requirements, permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction. Locate permanent markings in one corner, and in the same location, of each glass lite in accordance with the requirements of the SGCC labeling guidelines. Markings shall have a nominal size of no greater than 1-inch (25.4-mm) in diameter, and be located with glass edge clearances, at the corner, by not more than 3/4-inch (19-mm) up and 3/4-inch (19-mm) over.

E. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA's "Glazing Manual" and "Laminated Glass Design Guide."

F. Quality Control (Production) Testing: As a minimum, provide the following quality control (production) testing for the exterior glass units:

1. Bow and Warp Distortion (Flatness) Tolerance Testing:

   a. During the production of the heat-treated glass lites, measure for bow and warp in accordance with ASTM C 1048. Measure the lites on a vertical plane with an aluminum straight edge or fishing line.

      1) Measure the monolithic glass lites for compliance with the bow and warp tolerances under Article "Heat-Treated Float Glass," Paragraph "Flatness Tolerances," unless otherwise accepted by the Owner and Architect at the preconstruction glass mockup.

   b. During glass production, and once an hour, randomly select a single heat-treated glass lite and measure it. Document and record results. Tag each glass lite that falls outside of the maximum bow and warp limits and certify that these non-conforming glass lites were not incorporated into the Work.

   c. Provide written documentation of the bow and warp readings in fractions of an inch or millimeters for each tested glass lite to the Owner and Architect, if requested. Provide additional written documentation as requested by the Owner and Architect.

2. Roll Ripple Distortion (Flatness) Tolerance Testing:

   a. During the production of the heat-treated glass lites, measure each low emissivity coated, unfritted, monolithic glass lite having a 1/4-inch- (6-mm-) thickness or greater using a LiteSentry or Osprey Series type optical scanning measurement device complying with ASTM C 1652 for digital grid scanning glass devices. During the production of the 100 percent full screen, frit-coated monolithic heat-treated glass lites having a 1/4-inch- (6-mm-) thickness or greater, and at a frequency of at least once an hour, randomly select a monolithic single lite and measure it using a trolley type scanning measurement device complying with ASTM C 1651.

      1) Measure the monolithic glass lites for compliance with the flatness tolerances under Article "Heat-Treated Float Glass," Paragraph "Flatness Tolerances," unless otherwise accepted by the Owner and Architect at the preconstruction glass mockup.

   b. Document and record results for each glass lite. Tag each glass lite that falls outside of the maximum flatness limits and certify that these non-conforming glass lites were not incorporated into the Work.

      1) Provide written documentation of the flatness readings in fractions of an inch, in millimeters, and in millidiopters, for each glass lite to the Owner and Architect, if requested. Provide additional written documentation as requested by the Owner and Architect.

3. Color Tolerance Testing: During production, test monolithic coated and coated insulating glass units for color compliance as follows:

    a. Establish a color target selected from the accepted pre-construction glass mockup unit(s) and perform quality control color control checks using either an off-line, or on-line, spectrophotometer. Examples of acceptable off-line devices include Minolta 2500d/2600d; examples of acceptable on-line devices include Benchmodel Spectrophotometers. Color measurement shall be taken from the uncoated side.
    b. Frequency: Test a minimum of one unit every hour.
    c. Document and record results for each glass unit. Tag each unit of glass that falls outside of the color variation limits and certify that these non-conforming glass units will not be incorporated into the Work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Deliver film to Project site, and handle/store in accordance with manufacturer's instructions, in unopened containers and in a manner that will ensure no deterioration of, or detrimental effects on, film and its system for adhering to glass. Protect from weather and physical abuse.

1.7 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.

1.8 WARRANTY

A. Manufacturer's Special Warranty on Ceramic Frit-Coated-Glass Products: Written warranty, made out to Owner and signed by coated-glass manufacturer agreeing to furnish replacements for those coated-glass units whose coatings flake, peel, or crack within the specified warranty period indicated below. Upon notification of such deterioration within the warranty period, furnish replacement glass units for those glass units whose coatings have flaked, peeled or cracked at the convenience of the Owner.

    1. Warranty Period: Five years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Laminated Glass: Written warranty, made out to Owner and signed by laminated-glass manufacturer agreeing to furnish replacements for laminated-glass units that develop edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those specified within the warranty period indicated below. Upon notification of such deterioration within the warranty period, furnish replacement glass units for those glass units having edge separation, delamination, and blemishes at the convenience of the Owner.

1. Warranty Period: Five years from date of Substantial Completion.

C. Heat-Soaked Tempered Glass Special Warranty: Executed by the Contractor, manufacturer and the glass installer agreeing to replace glass units that spontaneously break as a result of Nickel Sulfide (NiS) inclusions within the specified warranty period without material or labor charges to the Owner.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Refer to Finish Schedule on the Drawings for the extent of glass types and locations. The Contractor shall confirm the levels of heat-treatment required for each glass type scheduled as contained in "Performance Requirements" and "Quality Assurance" Articles.

2.2 PERFORMANCE REQUIREMENTS

A. General: Provide and install watertight and airtight glazing systems capable of withstanding thermal movement and wind and impact loads without failure of any kind, including loss or breakage of glass, failure of seal or gaskets, exudation of glazing sealants, and excessive deterioration of glazing materials.

B. Glass Design: Glass thicknesses and heat treatments indicated are minimum requirements. Glazing details shown are for convenience of detailing only and are to be confirmed by the Contractor relative to cited standards and final framing details.

2.3 PRIMARY FLOAT GLASS

A. Float Glass: ASTM C 1036, Type I (transparent glass, flat), Quality q3 (glazing select); Class 1, clear Class 1, ultra clear low iron with visible light transmission of not less than 91 percent as indicated in schedules.

1. Ultra Clear, Low Iron Glass: Where indicated in the schedules clear, low iron glass shall mean low iron products as follows:

a. AGC Asahi Glass Co. Ltd.; Krystal Klear.
b. Guardian Industries Corp.; UltraWhite.
c. Pilkington North America; Optiwhite.
d. Vitro S.A.B. de C.V. "Starphire."

2.4 HEAT-TREATED FLOAT GLASS

A. General: Heat-treat glass where the need is determined by thermal stress analyses, by wind load analyses, and where required to meet safety glazing requirements.

B. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of installed glass unit.

C. Sizes and Cutting: Prior to heat treatment, cut glass to required sizes as determined by accurate measurement of openings to be glazed, making allowance for required edge clearances. Cut and process edges in accordance with glass manufacturer's recommendations. Do not cut or treat edges in the field. Make all cuts for hardware, access, or glass-mounted trim or accessories before heat treating.

D. Heat-Strengthened Glass: Provide glass complying with ASTM C 1048 Kind HS. Surface compression range shall be between 4,000 psi (27.6 MPa) and 7,000 psi (48.3 MPa) for 1/4 inch (6 mm) thick glass.

1. Heat-Strengthened Glass Quality Imperfection Limitations: In addition to the limitations included under ASTM C 1048, all glass shall be supplied meeting the following quality standards:

a. Chill cracks, roller marks, and picture framing shall not be permitted.
b. Tracking/cloud and heat dimples shall be rejected if detectable at 10 feet (3048 mm).

E. Fully Tempered Glass: Provide glass complying with ASTM C 1048 Kind FT and meeting the requirements of ANSI Z97.1 for Category A performance and 16 CFR 1201 for Category II performance. Surface compression shall be equal to or greater than 10,000 psi (69 MPa). After tempering, heat-soak 100 percent of all fabricated glass units to European Union Standard EN14179 to reduce the potential for inclusion related glass breakage. Statistical heat soaking shall not be permitted.

F. Flatness Tolerances: All heat-treated glass shall be fabricated to the following flatness tolerances. Verification of compliance for overall bow and warp shall be in accordance with ASTM C 1048. Verification of compliance for flatness shall be via an optical scanning device such as LiteSentry or Osprey Series.

1. Overall Bow and Warp: Not greater than the maximum bow and warp tolerances in any direction as listed in ASTM C 1048 Table 2. Localized warp limited to 1/32 inch in 12 inches (0.79 mm in 304.8 mm).

2. Roll Ripple: The deviation from flatness at any peak (peak to valley deviation) shall not exceed 0.003 inches for 6 mm (0.0762 mm for 6 mm) thick glass in the glass center, with leading and trailing edge deviation not to exceed 0.008 inches for 6 mm (0.2032 mm for 6 mm) thick glass.

G. Millidiopter Criteria: Maximum +/- 120 millidiopters overall or the highest overall measurement from the approved visual mockup that is less than +- 120 millidiopter overall whichever is less when viewed outdoors.

2.5 CERAMIC-COATED GLASS

A. Ceramic-Coated Vision Glass: Float glass with ceramic coating applied by silk-screened process and complying with ASTM C 1048, Condition C (other coated glass), Type I (transparent glass, flat), Quality q3 (glazing select); and complying with Specification No. 95-1-31, "Specification for Decorative Architectural Flat Glass" in GANA's "Engineering Standards Manual"; and with other requirements indicated in glass schedules.

2.6 LAMINATED GLASS

A. Laminated Glass: Comply with ASTM C 1172 for kinds of laminated glass indicated and other requirements specified.

1. GL-03: 10.76 mm (2 layers of 5 mm glass + 2 lyaers PVB); OITC-36; STC- 34.

B. Interlayer: Unless indicated otherwise, provide 0.060 inch (1.5 mm) thick polyvinyl butyral (PVB) sheet or ionoplast sheet interlayer material with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation.

1. All interlayer furnished for the Project shall have been manufactured by one of the following:

a. Eastman Chemical Company.
b. Kuraray.

C. Laminating Process: Prior to laminating, cut glass to required sizes and profiles as determined by accurate measurement of openings to be glazed, making allowance for required edge clearances. Cut and process edges in accordance with glass manufacturer's recommendations. Do not cut or treat edges in the field. Fabricate laminated glass to produce glass free of scuff vinyl markings, handprints, tag residue, and foreign substances such as lint, hair, vinyl shavings in the central glass area and the outer 20 percent area when viewed from a distance of 39 inches (1 meter) and 10 feet (3048 mm), respectively. Handprints, tag residue, scuff vinyl markings, and foreign substances must be separated by more than 12 inches (300 mm) if not detectable at less than the viewing distances. Delaminations, blow-ins, short interlayers, and air or gas pockets shall not be permitted in the central glass area. In the outer 20 percent area, delamination will not be permitted; blow-ins, air or gas pockets, and short interlayers shall be limited to a maximum dimension of 3/32 inch (2.38-mm) in diameter, 3/32 inch (2.38-mm) in diameter, and 1/16 inch (1.5-mm) long, respectively. Laminate units as follows:

1. Laminate lites with interlayer in autoclave with heat plus pressure.

2.7 FIRE-RATED GLAZING PRODUCTS

A. Laminated Ceramic Glazing Material: Two lites of clear ceramic glazing material laminated together to produce a laminated lite of minimum 5/16 inch (8 mm) nominal thickness; polished on both surfaces; weighing 4 lb/sq. ft. (19.5 kg/sq. m); and as follows:

1. Fire-Protection Rating: As indicated for the assembly in which the glazing material is installed, and permanently labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
2. Polished on both surfaces, transparent.
3. Product: Provide one of the following:

    a. "FireLite Plus"; Nippon Electric Glass Co., Ltd. and distributed by Technical Glass Products.
    b. Pyran Platinum L; SaftiFirst div. of O'Keeffe's, Inc.
    c. Keralite FR-L; Vetrotech.

2.8 GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:

1. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Gasket, Blocking, and Spacer Wet Glazing Materials: Silicone, compatible with and adherent to each material it will be in contact with, as recommended by the manufacturer to fulfill performance requirements.

C. Structural and Butt Glazing Sealants: Refer to Section 07 92 00 "Joint Sealants," Article "Elastomeric Joint Sealants," subparagraph "Structural Glazing."

D. Glazing Sealant for Fire-Resistive Glazing Products: Identical to product used in test assembly to obtain fire-protection rating.

1. VOC Content: Provide glazing sealants and sealant primers having not more than 100 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.9 GLAZING GASKETS

A. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock strips, complying with ASTM C 542, black.

B. Dense Compression Gaskets:

1. Neoprene: Continuous extruded neoprene with, cross sectional profile, physical properties, and tolerances as recommended by the window and curtain wall manufacturer, and as required, to comply with the performance requirements specified and shown all in compliance with the applicable provisions of ASTM C 864, Option II. Provide injection molded corners.
2. EPDM: Continuous extruded EPDM with cross sectional profile, physical properties, and tolerances as recommended by the window and curtain wall manufacturer, and as required, to comply with the performance requirements specified and shown all in compliance with the applicable provisions of ASTM C 864, Option II. Provide injection molded corners.
3. Silicone: Continuous extruded silicone with cross sectional profile, physical properties, and tolerances as recommended by the window and curtain wall manufacturer, and as required, to comply with the performance requirements specified and shown all in compliance with the applicable provisions of ASTM C 1115, Type C. Provide injection molded corners.
4. Thermoplastic Polyolefin Rubber: Continuous extruded thermoplastic polyolefin rubber with cross sectional profile, physical properties, and tolerances as recommended by the window and curtain wall manufacturer, and as required, to comply with the performance requirements specified and shown all in compliance with the applicable provisions of ASTM C 1115. Provide injection molded corners.
5. Any material indicated above.

C. Soft Compression Gaskets: Continuous extruded expanded foam with, cross sectional profile, physical properties, and tolerances as recommended by the window and curtain wall manufacturer, and as required, to comply with the performance requirements specified and shown all in compliance with the applicable provisions of ASTM C 509, Option II, Type II; provide the following:

1. Neoprene.
2. EPDM.
3. Silicone.
4. Thermoplastic polyolefin rubber.
5. Any material indicated above.

D. Continuous Structural Gaskets/Spacers: Continuous extruded silicone or silicone compatible rubber, with cross sectional profile, physical properties, and tolerances as recommended by the window and curtain wall manufacturer, and as required, to comply with the performance requirements specified and shown. Gaskets/spacers shall be tested for compatibility with silicone sealants and shall be subject to the acceptance of the sealant manufacturer.

2.10 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces, and wet glazing materials, contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: EPDM complying with ASTM C 864 (Option II), blocks, 85 +/- 5 Shore A durometer hardness, 1/16 inch (1.5 mm) less than the channel width, and length based on the face area of the glass unit to be supported in accordance with GANA standards and glass manufacturer recommendations, but not less than 4 inches (101.6 mm).

D. Setting Blocks: Silicone complying with ASTM C 1115 (Type C), blocks, 85 +/- 5 Shore A durometer hardness, 1/16 inch (1.5 mm) less than the channel width, and length based on the face area of the glass unit to be supported in accordance with GANA standards and glass manufacturer recommendations, but not less than 4 inches (101.6 mm).

E. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness of 40 to 60.

F. Edge Blocks: Silicone complying with ASTM C 1115 (Type C), blocks, 65 +/- 5 Shore A durometer hardness, minimum 4 inches (101.6 mm) long and sized to allow 1/8 inch (3.18 mm) clearance between edge of glass and block.

G. Edge Blocks: EPDM complying with ASTM C 864 (Option II), blocks, 65 +/- 5 Shore A durometer hardness, minimum 4 inches (101.6 mm) long and sized to allow 1/8 inch (3.18 mm) clearance between edge of glass and block.

H. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.

I. Applied Film: A water-resistant, permanent, translucent patterned vinyl film laminated to a clear pressure sensitive adhesive and transparent synthetic liner.

1. Color and Pattern: Refer to Finish Schedule on the Drawings.

2.11 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing standard, to comply with system performance requirements.

1. Edge and Surface Conditions: Comply with the recommendations of AAMA "Structural Properties of Glass" for "clean-cut" edges, except comply with manufacturer's recommendations when they are at variance therewith.

B. Cutting: Do not nip glass edges. Edges may be wheel cut or sawed and seamed at manufacturer's option. For glass to be cut at site, provide glass 2 inches (50.8 mm) larger than required in both dimensions, so as to facilitate cutting of clean cut edges without the necessity of seaming or nipping. Do not cut, seam, nip or abrade heat-treated glass.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine glass framing, with glazier and glass framing erector present, for compliance with the following:

1. Compliance with the specified manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Minimum required face or edge clearances.
3. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing stops, glazing channels, and rabbets which will be in contact with the glazing materials immediately before glazing. Loose particles present or resulting from fabrication and cleaning shall be removed by blowing out joints with oil-free compressed air, or by vacuuming joints. Remove protective coatings, oils from cutting and drilling operations, and residue on metallic surfaces with solvents that leave no residue. Do not allow solvent to air dry without wiping. Use only lint-free towels for wiping of surfaces. Wipe metal surfaces with IPA (isopropyl alcohol) unless otherwise required by compatibility and adhesion testing results.

1. Prime surfaces to receive glazing compounds. When priming, comply with wet glazing manufacturer's recommendations.

B. Inspect each glass unit immediately before installation. Do not install any units which are improperly sized or have damaged edges, scratches or abrasion or other evidence of damage. Remove labels from glass immediately after installation.

C. Substrate Preparation for Applied Film: Clean glass surfaces to receive the application of applied film. Remove foreign deposits, including paint spatter and glazing sealant materials that have migrated from glazing channel. Wash with detergent, rinse, and dry each glass surface immediately prior to film application; comply with film manufacturer's instructions and recommendations. Control and limit unnecessary activities, occupancies, air movements, and similar incidents in each space of the building during the time of cleaning and film application so as to ensure the best possible environment for application of film on clean substrates. Comply with environmental conditions as recommended by film manufacturer prior to applying film to glass.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

1. All glass units shall be installed in accordance with the glass manufacturer's recommendations.

B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to surfaces indicated to receive glazing materials. Use primers as determined by preconstruction compatibility and adhesion testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless more stringent requirements are recommended by glass manufacturer. Place blocks to allow water passage to weep holes. Set blocks in thin course of silicone sealant.

1. For Glass Units Less Than 72 inches (1830 mm): Locate setting blocks at sill one-quarter of the width in from each end of the glass, unless otherwise recommended by the glass manufacturer.
2. For Glass Units 72 inches (1830 mm) or Greater: Locate setting blocks at sill one-eighth of the width in from each end of the glass, but not less than 6 inches (150 mm), unless otherwise recommended by the glass manufacturer.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide edge blocking to prevent glass lites from moving sideways in glazing channel, sized and located to comply with the glass manufacturer's recommendations and the requirements in referenced glazing publications.

1. Edge blocking will not be required at structural glazed window and curtain walls unless specifically required by the glass manufacturer for the conditions shown.

H. Set glass lites with uniform pattern, draw, bow, and similar characteristics, producing the greatest possible degree of uniformity in appearance on the entire exterior wall elevation.

1. Set glass units with void between edge of units and glazing channel.

I. Where wedge-shaped gaskets are driven into one side of channel to pressurize gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

J. Miter cut gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away and join with sealant recommended by gasket manufacturer which will provide an airtight and watertight seal at the joint.

K. Film Application: Comply with film manufacturer's installation requirements, instructions, and recommendations. Avoid seams whenever possible and, where not possible, minimize the number of seams. Produce seams which are tightly-butted, without overlaps and gaps which are visible only at viewing distances of 20 inches (508 mm) and less. Apply film by method which will ensure the inclusion of no air bubbles or other foreign substances.

1. Extend film to cover full expanse of each glass sheet to receive film, but without either overlapping the glass glazing materials, or leaving edge gaps of more than 1/32 inch (0.8 mm).
2. In order to minimize the possibility of visible differences in the color or shading intensity of the butted films at seams, apply each film with its butted edge taken from the same end of the film roll (reverse the direction-of-application). Remove and replace film application where mismatching of film is visually noticeable where directed by Architect.
3. Exercise extreme care during application of film, including the cutting and pressing-in-place of film, so as to avoid the scoring and abrading of surfaces of glass.
4. Adhere film to glass using procedures recommended by film manufacturer. Press into place to ensure that entire film sheet, including edges, are firmly and permanently adhered.

3.4 LOCK-STRIP GASKET GLAZING

A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Use special tool to install and remove filler strips; lubricate in accordance with manufacturer's instructions. Provide supplementary wet seal and weep system, unless otherwise indicated.

3.5 PROTECTION AND CLEANING

A. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.

B. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way and from any source, including natural causes, accidents, and vandalism.

C. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass and film as recommended by glass and film manufacturer.

END OF SECTION 08 80 00

SECTION 08 83 00 - MIRRORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes mirrored glass with vinyl-backing safety film.

1.2 ACTION SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other Work.

C. Samples: As follows:

1. Mirrored Glass: 12 inches (300 mm) square, including safety backing and edge treatment on 2 adjoining edges.
2. Mirror clips.
3. Mirror Trim: 12 inches (300 mm) long.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product certificates.

C. Preconstruction Test Report: For mirror mastic compatibility.

D. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Glazier Certification Program as Level 2 (Senior Glaziers) or Level 3 (Master Glaziers).

B. Glazing Publications: Comply with published recommendations in GANA's "Glazing Manual," unless more stringent requirements are indicated.

C. NAAMM's Publication: For silvered mirrored glass, comply with recommendations in NAAMM's "Mirrors, Handle with Extreme Care, Tips for the Professional on the Care and Handling of Mirrors."

D. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201.

E. Preconstruction Compatibility Test: Submit mirror mastic products to organic protective coating manufacturer for testing to determine compatibility of adhesive with mirrored glass coating.

1.5 DELIVERY, STORAGE, AND HANDLING

A. For silvered mirrored glass, comply with mirrored glass manufacturer's written instructions for shipping, storing, and handling mirrored glass as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors, protected from moisture including condensation.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrored glass units that deteriorate f.o.b. the nearest shipping point to Project site, within five years from date of Substantial Completion.

1. Deterioration of Silvered Mirrored Glass: Defects developed from normal use not caused by maintaining and cleaning mirrored glass contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Products: Subject to compliance with requirements, provide one of the products specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 FLOAT GLASS

A. Annealed Float Glass: ASTM C 1036, Type I (transparent glass, flat).

1. Clear: Class 1 (clear), Quality q2 (mirror).

a. Thickness: 6 mm.

2.3 MIRRORED GLASS

A. Silvered Mirrored Glass:

1. Manufacturers:

    a. American Mirror Company, Inc.
    b. Carolina Mirror Company.
    c. Donisi Mirror Company.
    d. Gardner Glass Products.
    e. Gilded Mirrors, Inc.
    f. Lenoir Mirror Company.
    g. Stroupe Mirror Co., Inc.
    h. Sunshine Mirror.
    i. Virginia Mirror Co., Inc.
    j. VVP America, Inc.; Binswanger Mirror Products.
    k. Walker Glass Co., Ltd.

2. Annealed Float Glass: Clear.
3. Silvering: Successive layers of chemically deposited silver, electrically or chemically deposited copper, and manufacturer's standard organic protective coating applied to second glass surface to produce coating system complying with FS DD-M-411.

B. Fabrication:

1. Cutouts: Fabricate cutouts for notches and holes in mirrored glass without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrored glass.
2. Mirrored Glass Edge Treatment: Rounded polished.

    a. Silvered Mirror Glass: Seal edges after edge treatment to prevent chemical or atmospheric penetration of glass coating.
    b. Factory Fabricate: Perform edge treatment and sealing in factory immediately after cutting to final sizes.

C. Vinyl-Backed Safety Mirrored Glass: Apply vinyl backing with pressure-sensitive adhesive coating over glass coating as recommended by vinyl-backing manufacturer to produce a surface free of bubbles, blisters, and other imperfections. Use adhesives and vinyl backing compatible with mirrored glass as certified by organic coating manufacturer.

2.4 MISCELLANEOUS MATERIALS

A. Edge Sealer: Coating compatible with glass coating and approved by mirrored glass manufacturer for use in protecting against silver deterioration at mirrored glass edges.

B. Mirror Mastic: An adhesive setting compound, produced specifically for setting mirrored glass by spot application and not containing asbestos.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Qwikset Mirro-Mastic®by Palmer Products Corporation.
    b. UltraBond by Gunther Mirror Mastics.

C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.

1. Basis-of-Design: Royal Adhesives & Sealants, LLC; Premier Plus®®.
2. Subject to compliance with requirements, provide the Basis-of-Design or a comparable product by one of the following:

    a. Franklin International.
    b. Laurence, C. R. Co., Inc.
    c. Liquid Nails Adhesive.
    d. Palmer Products Corporation.
    e. Royal Adhesives & Sealants, LLC.

3. Adhesives shall have a VOC content of 70 g/L or less.

D. Stainless Steel Top and Bottom Trim: J-channels with return that produces glazing channel to accommodate mirrored glass thickness indicated.

1. Bottom and Top Trim: J-channels formed with front leg and back leg not less than 5/16 and 7/8 inch (8 and 22 mm) in height, respectively.

    a. Product:

        1) C. R. Laurence Co., Inc.; CRL Stainless Steel "J" Channel, No. SS960.

E. Extruded-Aluminum Top and Bottom Trim: J-channels with return that produces glazing channel to accommodate mirrored glass thickness indicated.

1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch (9.5 and 22 mm) in height, respectively, and a thickness of not less than 0.05 inch (1.3 mm).

    a. Products:

        1) C. R. Laurence Co., Inc.; CRL Standard "J" Channel.
        2) Sommer & Maca Industries, Inc.; Heavy Gauge Aluminum Shallow Nose "J" Moulding Lower Bar.

2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch (16 and 25 mm) in height, respectively, and a thickness of not less than 0.062 inch (1.57 mm).

    a. Products:

1) C. R. Laurence Co., Inc.; CRL Deep "J" Channel.
2) Sommer & Maca Industries, Inc.; Heavy Gauge Aluminum Deep Nose "J" Moulding Lower Bar.

3. Aluminum Finish: Satin anodized.

F. Fasteners: Fabricated of same basic metal and alloy as fastened metal.

G. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify compatibility with and suitability of substrates, including compatibility of mirror mastic with existing finishes or primers.

B. Install mirrored glass units to comply with written instructions of mirrored glass manufacturer and with referenced GANA and NAAMM publications. Mount mirrored glass accurately in place in a manner that avoids distorting reflected images.

C. Provide space for air circulation between back of mirrored glass units and face of mounting surface.

D. Mastic Spot Installation System:

1. Apply barrier coat to mirrored glass backing where approved in writing by manufacturers of mirrored glass and backing material.
2. Apply mastic in spots to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrored glass units and face of mounting surface.
3. After mastic is applied, align mirrored glass units and press into place while maintaining a minimum air space of 1/8 inch (3 mm) between back of mirrored glass and mounting surface.

E. For wall-mounted mirrored glass units, install permanent means of support at bottom and top edges with bottom support designed to withstand mirrored glass weight and top support designed to prevent mirrored glass from coming away from wall along top edges.

1. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrored glass units.

2. For continuous bottom supports, provide setting blocks 1/8 inch (2 mm) thick by 4 inches (100 mm) long at quarter points. For channels or other continuous supports in which water could be trapped, provide, between setting blocks, two slotted weeps not less than 1/4 inch (3 mm) wide by 3/8 inch (4.5 mm) long.
3. Where indicated, install bottom and top trim. Fabricate trim in single lengths to fit and cover top and bottom edges of mirrored glass units.

F. Protect mirrored glass from breakage and contaminating substances resulting from construction operations.

1. Do not permit edges of silvered mirrored glass to be exposed to standing water.
2. Maintain environmental conditions that will prevent silvered mirrored glass from being exposed to moisture from condensation or other sources for continuous periods of time.

END OF SECTION 08 83 00

SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes non-structural metal framing assemblies.

1.2 PRE-INSTALLATION MEETING

A. Preconstruction Conference: Prior to start of the non-structural metal framing work, and at the Contractor's direction, meet at Project site and review the installation procedures and coordination with other work. Meeting shall include Contractor, Architect and major material manufacturer as well as the Installer and other subcontractors whose work must be coordinated with the non-structural metal framing and the gypsum wallboard work.

1.3 ACTION SUBMITTALS

A. Product Data: Submit product data for each product indicated.

B. Samples: Submit full size samples in 12 inch (300 mm) long lengths for each exposed trim accessory indicated.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For non-structural metal framing assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory."

B. Sound Transmission Characteristics: For non-structural metal framing faced with gypsum wallboard materials and having STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

1. STC-Rated Assemblies: Indicated by design designations from GA-600, "Fire Resistance Design Manual."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.6 FIELD CONDITIONS

A. Comply with ASTM C 754 requirements or wallboard material manufacturer's written recommendations, whichever are more stringent.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. General: For fire rated assemblies, provide materials, including accessories and fasteners produced by one manufacturer, or, when products of more than one manufacturer are used in a rated system, they shall be acceptable to authorities having jurisdiction.

2.2 PERFORMANCE REQUIREMENTS

A. Gypsum Board Assembly Deflections:

1. Typical Walls: Wall assemblies shall be constructed for deflection not to exceed 1/240 of the wall height when subjected to a positive and negative pressure of 5 psf (239 Pa).
2. Ceilings, bulkheads, soffits, ceiling transitions, ledges, and coves shall be constructed for a deflection not to exceed 1/360 of the distance between supports.

2.3 STEEL SUSPENDED CEILING FRAMING

A. Components, General: Provide steel framing members sized and spaced as indicated but not less than that required to comply with ASTM C 754 under the maximum deflection conditions specified under Article 'Assembly Performance Requirements.'

B. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625 inch (1.59 mm) diameter wire, or double strand of 0.0475 inch (1.21 mm) diameter wire.

C. Hanger Attachments to Overhead Decks: Suitable for application indicated, fabricated from corrosion-resistant materials, with eyepins, clips or other devices for attaching hangers and capable of sustaining, without failure, a load equal to 10 times that imposed by the complete ceiling system.

D. Hangers: As follows:

1. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162 inch (4.12 mm) diameter.
2. Flat Hangers: Commercial-steel sheet, ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized.

    a. Size: 1 by 3/16 inch (25.4 by 4.76 mm) by length indicated.

E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of 0.0538 inch (1.37 mm), a minimum 1/2 inch (12.7 mm) wide flange, with manufacturer's standard corrosion-resistant zinc coating.

F. Furring Channels (Furring Members): Commercial-steel sheet with ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized zinc coating. No equivalent coatings allowed.

1. Cold Rolled Channels: 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flange, 3/4 inch (19.1 mm) deep.
2. Steel Studs: ASTM C 645, 0.0312 inch (0.79 mm) minimum base metal thickness and minimum depth as required to suit deflection criteria.
3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22.2 mm) deep.

    a. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).

4. Resilient Furring Channels: 1/2 inch (12.7 mm) deep members designed to reduce sound transmission.

G. Grid Suspension System for Interior Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

2.4 STEEL PARTITION AND SOFFIT FRAMING

A. General: Provide steel framing members sized and spaced as indicated but not less than that required to comply with ASTM C 754 under the maximum deflection conditions specified under Article 'Assembly Performance Requirements.'

1. In areas where top of partitions are dependent on ceiling system for lateral support, coordinate design and installation to comply with the above deflection limitation.
2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized zinc coating. No equivalent coatings (EQ) allowed.

B. Steel Studs and Runners: ASTM C 645, in minimum depth indicated in partition type details; one of the following:

1. Allsteel & Gypsum Products, Inc.
2. CEMCO.
3. Clark Dietrich.
4. Consolidated Fabricators, Corporation.
5. Craco Manufacturing, Inc.
6. Custom Stud, Inc.
7. Marino\WARE.
8. Phillips Manufacturing Company.
9. Quail Run Building Materials, Inc.
10. SCAFCO Corporation.
11. Southeastern Stud & Components, Inc.
12. Telling Industries.
13. The Steel Network.
14. Minimum Base Metal Thickness:

    a. Typical: As required to comply with deflection criteria but not less than 0.0179 inch (0.45-mm).
    b. Partitions Supporting Wall Mounted Casework: 0.053 inch (1.3 mm) minimum thickness.

15. Depth: As indicated.

C. Double-Runner System: ASTM C 645 top runners, inside runner with custom fabricated flanges with depths sized to accommodate roof and floor deck live and dead load deflections but not less than 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.

D. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Delta Star, Inc., Superior Metal Trim; Superior Flex Track System (SFT).
    b. Metal-Lite, Inc.; Slotted Track.
    c. The Steel Network, Inc; VertiClip SLD Series or VertiTrack VTD Series.

E. Firestop Track: ASTM C 645 top runner with custom fabricated flanges with depths sized to accommodate roof and floor deck live and dead load deflections but not less than 2 inch (50.8 mm) deep flanges. Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
b. Metal-Lite, Inc.; The System.
c. The Steel Network, Inc.; VertiClip SLD Series or VertiTrack VTD Series.

F. Flat Strap and Backing Plate: 36 inch (914 mm) wide by 6 inch (150 mm) high steel sheet for blocking and bracing required for the attachment of surface mounted items and accessories indicated. Locate to span a minimum of 2 studs.

1. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).

G. Cold-Rolled Channel Bridging: For channel bridging for fixture attachment or lateral bracing provide 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flange:

1. Depth: 1-1/2 inches (38.1 mm).
2. Clip Angle: 1-1/2 by 1-1/2 inch (38.1 by 38.1 mm), 0.068 inch (1.73 mm) thick, galvanized steel.

H. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
2. Depth: 7/8 inch (22.2 mm).

I. Resilient Furring Channels: 1/2 inch (12.7 mm) deep, steel sheet members designed to reduce sound transmission.

J. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members securely to substrates involved; complying with the recommendations of the gypsum board manufacturers for applications indicated.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90. One of the following:

1. SHEETROCK Acoustical Sealant; U.S. Gypsum.
2. AC-20 FTR; Pecora.

C. Isolation Strip at Exterior Walls: Adhesive-backed, closed-cell, compressible, non-extruding, sound transmission reducing, vinyl foam tape strips with approximately 13 Shore 00 hardness that allow fastener penetration without foam displacement, 0.75 inch (19 mm) thick, in width 1/2 inch (12.7 mm) less than window mullion width.

1. V7324 Norton Sealant Tape; gray color.

D. Wood Blocking and Plywood Concealed in Partition Construction: Fire retardant treated, refer to Section 06 10 53 "Miscellaneous Rough Carpentry."

E. Metal Post for Tube Framing at Partial Height Walls: Refer to Section 05 50 00 "Metal Fabrications."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to which non-structural metal framing attaches or abuts, installed door frames and structural framing with Installer present for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed-on fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (600 mm) on center.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of the non-structural metal framing and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLING STEEL FRAMING, GENERAL

A. General: Install steel framing to comply with ASTM C 754, ASTM C 840 and the gypsum board manufacturer's recommendations, where standards conflict the more stringent shall apply.

B. Install supplementary framing, blocking, backerplates and bracing at locations in gypsum board assemblies which are indicated to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."

C. Isolate steel framing from building structure to prevent transfer of loading imposed by structural movement.

1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.

    a. Use deep-leg deflection track where indicated.
    b. Use proprietary firestop track where indicated.

3.4 INSTALLING STEEL SUSPENDED CEILING FRAMING

A. Suspended Ceiling Framing:

1. Suspend ceiling hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
3. Attach hangers to structural members. Do not support ceilings from or attach hangers to permanent metal forms, steel deck tabs, steel roof decks, ducts, pipes, or conduit.
4. Secure wire hangers by looping and wire-tying, to eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
5. Secure rod and flat hangers to structure, including intermediate framing members, by attaching to devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.

B. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member and transversely between parallel members.

C. Wire-tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.

D. Install suspended steel framing components in sizes and spacings indicated, but not less than that required by the referenced steel framing and installation standards unless more stringent spacings are recommended by the gypsum board manufacturer.

E. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

3.5 INSTALLING STEEL PARTITION AND SOFFIT FRAMING

A. Install continuous runners (tracks) sized to match studs at floors, ceilings, and structural walls and columns where gypsum board stud assemblies abut other construction. Secure runners to substrates with fasteners spaced a maximum of 24 inches (600 mm) on center unless closer spacing is recommended by the framing manufacturer for the floor and ceiling construction involved. Provide fasteners at all corners and ends of runner tracks.

1. Where studs are installed directly against exterior walls, install foam gasket isolation strip between studs and wall.
2. Install two beads of sealant below floor tracks for acoustical and dust control.

B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by the faces of adjacent framing.

C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings and at partial height partitions. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.

1. Cut studs 1/2 inch (13 mm) short of full height to provide perimeter relief.
2. For fire-resistance-rated and STC-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.
3. Terminate partition framing at suspended ceilings where indicated.
4. Terminate partial height partition framing as indicated.

D. Install steel studs and furring in sizes and at spacing indicated but not less than that required by the referenced steel framing installation standard to comply with maximum deflection and minimum loading requirements specified, unless more stringent requirements are recommended by the gypsum board manufacturer:

1. Space studs 16 inches (400 mm) on center, unless otherwise indicated.

E. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.

F. Install backerplates for support of wall mounted items.

G. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

1. Install two studs at each jamb, unless otherwise indicated. Install one additional stud no more than 6 inches (150 mm) from jamb studs at single doors greater than 48 inches (1200 mm) and at all pairs of doors.
2. Install cripple studs at head adjacent to each jamb stud. Provide runner track and typical studs above door openings with studs spaced not more than 24 inches (600 mm) on center.
3. At all welded frames with fixed anchor clips secure stud reinforcing to jamb anchor clips with not less than two self tapping screws per clip.
4. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.

H. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

I. Isolation Strip Attachment: Where partitions abut exterior wall window mullions, and partition filler panels are not indicated, adhesively attach isolation strips to window mullions. Center isolation strips on mullion to form a continuous, sound resistant and lightproof, recessed joint seal for the entire length of the interface between the partition studs and trim members and the vertical window mullions.

3.6 CLEANING AND PROTECTION

A. Clean floors of all non-structural metal framing debris and leave broom clean. Excess material, scaffolding, tools and other equipment are to be removed upon completion of the Work.

B. Provide final protection and maintain conditions that ensure non-structural metal framing work remains without damage or deterioration at time of Substantial Completion.

END OF SECTION 09 22 16

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.

1.2 PRE-INSTALLATION MEETING

A. Prior to start of each type of gypsum board system, and at the Contractor's direction, meet at the site and review the installation procedures and coordination with other Work. Meeting shall include Contractor, Architect and major material manufacturer, as well as the Installer and other subcontractors whose Work must be coordinated with the gypsum board Work.

1.3 ACTION SUBMITTALS

A. Samples: Submit full size samples in 12 inch (300 mm) long lengths for each exposed trim accessory indicated.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility for Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer.

B. Single-Source Responsibility for Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.

C. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for the following:

    a. Each level of gypsum board finish indicated for use in exposed locations.

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.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

C. Handle gypsum board to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads and trim.

1.6 FIELD CONDITIONS

A. Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory."

B. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

1. STC-Rated Assemblies: Indicated by design designations from GA-600, "Fire Resistance Design Manual."

2.2 MATERIALS, GENERAL

A. General: For fire rated assemblies, provide materials, including accessories and fasteners produced by one manufacturer, or, when products of more than one manufacturer are used in a rated system, they shall be acceptable to authorities having jurisdiction.

2.3 INTERIOR GYPSUM BOARD

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Gypsum.
2. CertainTeed Corp.
3. Georgia-Pacific Gypsum LLC.
4. Continental Building Products/Lafarge North America Inc.
5. National Gypsum Company.
6. PABCO Gypsum.
7. USG Corporation.

B. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

C. Gypsum Board: ASTM C 1396/C 1396M.

1. Type X:

a. Thickness: 5/8 inch (15.9 mm).
b. Long Edges: Tapered.
c. Location: Vertical surfaces, where required for fire-resistance-rated assembly, and where indicated on Drawings.

D. Gypsum Ceiling Board: ASTM C 1396/C 1396M, manufactured to have more sag-resistance than regular-type gypsum board.

1. Thickness: 1/2 inch (12.7 mm).
2. Long Edges: Tapered.
3. Location: Interior ceiling surfaces.

E. Moisture and Mold Resistant Board: ASTM C 1396/C 1396M; with moisture- and mold-resistant core and facing surfaces.

1. Core: 5/8 inch (15.9 mm).
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
4. Location: Interior ceiling surfaces.

2.4 TRIM ACCESSORIES

A. Interior Steel Trim Accessories: ASTM C 1047; formed metal sheet steel zinc coated by hot-dipped process. Shapes indicated below by reference to Fig. 1 designations in ASTM C 1047.

1. Cornerbead: Use at outside corners.

2. LC-Bead with both face and back flanges to receive joint compound; use at exposed panel edges.
3. U-Bead with face and back flanges; face flange formed to be left without application of joint compound: Use where indicated.
4. Expansion (Control) Joint: One-piece control joint formed with V-shaped slot, with removable strip covering slot opening. Use where indicated.

B. Aluminum Trim Accessories: Extruded aluminum trim with 1/4 inch (6.35 mm) diameter holes in fins for attachment to gypsum board or studs; longest lengths available in profiles indicated; primed for finish painting; sized for scheduled gypsum board thickness shown.

C. Vinyl Trim Accessories: Trim Tex.

2.5 JOINT TREATMENT MATERIALS

A. General: Provide joint treatment materials complying with ASTM C 475 and the recommendations of both the manufacturers of the products and joint treatment materials for each application indicated.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Paperless Gypsum Board: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, flanges of trim accessories, and fasteners, use setting-type taping compound.
3. Second Coat: For filling over tape, beads and fasteners. Use setting-type, sandable topping compound.
4. Third Coat: For finishing over tape, beads and fasteners. Use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

D. Joint Compound for Specialty Boards: As recommended by manufacturer.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90. One of the following:

1. SHEETROCK Acoustical Sealant; U.S. Gypsum.
2. AC-20 FTR; Pecora.

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
2. Product: Subject to compliance with requirements, provide one of the following:

    a. Roxul AFB; Roxul Inc.
    b. Rockwool Acoustic Slabs; Rockwool Ltd.
    c. SAFB Blankets; Thermafiber LLC.

E. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Adhesives shall have a VOC content of 50 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to which gypsum board assemblies attach or abut, installed door frames and structural framing with Installer present for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS

A. Gypsum Board Application and Finishing Standards: Install and finish gypsum panels to comply with ASTM C 840, GA-216, and the gypsum board manufacturer's recommendations, where standards conflict, the more stringent shall apply. Install specialty gypsum board as specified below except where manufacturer's instructions conflict; follow manufacturer's instructions for specialty performance board to maintain warranty coverage.

B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

C. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints or avoid them entirely.

    a. Stagger abutting end joints not less than one framing member in alternate courses of board.
    b. At high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.

D. Multilayer Application:

1. 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.
2. On Ceilings: Apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply base layers in same sequence. Apply base layers at right angles to framing members and offset face layer joints one framing member, 16 inches (406 mm) minimum, from parallel base joints, unless otherwise indicated or required by fire-resistance-rated assembly.

E. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.

F. Multilayer Fastening Methods: Fasten base layers and face layers separately to supports with screws.

G. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

H. Install gypsum panels with face side out. Do not install imperfect, damaged, or damp panels. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

I. 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.

J. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

K. Attach gypsum panels to framing provided at openings and cutouts.

L. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Fit gypsum panels around ducts, pipes, and conduits.
2. Where partitions intersect open exterior and interior wall kickers, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by the wall kickers and other structural members; allow 1/4 to 3/8 inch (6.4 to 9.5 mm) wide joints to install sealant.
3. Where chase walls are shown, provide bracing between parallel rows of studs. Unless otherwise shown, provide gypsum board braces no less than 1/2 inch (12.7 mm) thick by 12 inches (300 mm) wide and cut to width of chase. Locate at quarter points in wall height between each pair of parallel studs. Fasten with not less than 3 screws at each stud.

M. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4 to 1/2 inch (6.4 to 12.7 mm) wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

N. STC-Rated Assemblies: Seal construction at perimeters, behind control and expansion joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.

O. Cut openings in gypsum board for electrical outlets, piping and other penetrations. Maintain close tolerances so that edges will be covered by plates and escutcheons. Cut both face and back paper. Do not install electrical outlets back to back on opposing sides of partitions.

P. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.

1. Space screws a maximum of 12 inches (304.8 mm) o.c. for vertical applications.
2. Space fasteners in panels that are tile substrates a maximum of 8 inches (203.2 mm) o.c.
3. Install fasteners not less than 3/8 inch (9.5 mm) from ends or edges of gypsum board sheets, spacing fasteners opposite each other on adjacent ends or edges.
4. Begin fastening from center of gypsum board and proceed toward edges and corners.
5. Apply pressure on surface of gypsum board adjacent to fasteners being driven to ensure that gypsum board will be secured tightly to supporting members.

    a. Drive fastener with shank perpendicular to face of board.

b. Drive screws with a power screwdriver as recommended by gypsum board manufacturer. Set heads of screws slightly below surface of paper without cutting paper.

3.3 INSTALLING TRIM ACCESSORIES

A. General: Fasten trim accessories according to manufacturer's written instructions for type, length, and spacing of fasteners.

B. Install corner beads at external corners.

C. Install interior trim accessories where edge of gypsum panels would otherwise be exposed or semiexposed. Provide interior trim accessories with face flange formed to receive joint compound.

D. Install aluminum trim accessories where indicated.

E. Install control joints in locations indicated and where directed by the Architect for visual effect, or if not indicated or directed by the Architect, provide control joints in accordance with ASTM C 840 which is as follows:

1. Where a partition, wall or ceiling traverses a construction joint (expansion, seismic, or building control element) in the base building structure.
2. Where a wall or a partition runs in an uninterrupted straight plane exceeding 30 linear feet (9,100 mm).
3. Control joints in interior ceilings with perimeter relief shall be installed so that linear dimensions between control joints do not exceed 50 feet (15,000 mm) and total area between control joints does not exceed 2500 square feet (230 sq m).
4. Control joints in interior ceilings without perimeter relief shall be installed so that linear dimensions between control joints do not exceed 30 linear feet (9,100 mm) and total area between control joints does not exceed 900 square feet (84 sq m).
5. A control joint or intermediate blocking shall be installed where ceiling framing members change direction.

3.4 FINISHING GYPSUM BOARD ASSEMBLIES

A. General: Apply joint treatment at gypsum board joints, flanges of interior trim and aluminum trim accessories, interior angles, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration and levels of gypsum board finish indicated. Produce surfaces free of tool marks and ridges ready for decoration of type indicated. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Glass-Mat, Water-Resistant Backing Panels: Do not use paper tape and joint compound. Finish according to manufacturer's written instructions.

E. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:

1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile and where indicated.
3. Level 3: Typically not used.
4. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.
5. Level 5: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat of joint compound over entire surface where gypsum board is indicated to receive wall coverings, semi-gloss and high gloss paints, and Italian plaster.

3.5 CLEANING AND PROTECTION

A. Clean floors of all gypsum board debris and leave broom clean. Excess material, scaffolding, tools and other equipment are to be removed upon completion of the Work.

B. Provide final protection and maintain conditions that ensure gypsum board assemblies remain without damage or deterioration at time of Substantial Completion.

END OF SECTION 09 29 00

SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes acoustical panels and exposed suspension systems for ceilings.

1.2 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: Submit product data for each type of product indicated.

B. Shop Drawings: Submit shop drawings of reflected ceiling plans drawn accurately to large scale and coordinating penetrations and ceiling-mounted items. Show the following:

1. Patterns of ceiling suspension assembly members with setting out/work points.
2. Method of attaching hangers to building structure.
3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.

C. Samples: Submit samples for each acoustical panel, for each exposed suspension system member, for each exposed molding and trim, and for each color and texture required, prepared on Samples of size indicated below. Samples shall show the full range of color and texture variations to be expected in the final installation.

1. Acoustical Panel: Set of 6-inch (150-mm) square Samples of each type, color, pattern, and texture.
2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch (300-mm) long Samples of each type, finish, and color.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish and store at the site where directed, 2 percent of each type of acoustic panel installed in the Project, packaged in manufacturer's unopened cartons and identified as to contents.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an Installer, with not less than 5 years experience in the installation of materials specified, and who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance.

B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.

C. Performance Requirements: In areas where gypsum wallboard partitions are dependent on the ceiling suspension system for lateral support, design and install suspension system components to sustain the imposed load from the completed partition system including a minimum inward and outward pressure of 5 psf (239 Pa) normal to the plane of the wall.

D. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of Seismic Zone 3 earthquake motions according to the following:

1. CISCA's Guidelines for Systems Requiring Seismic Restraint: Comply with CISCA's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies--Seismic Zones 3 & 4."

E. Sample Installations: Before installing acoustical panel ceilings, install sample installations for each type of acoustical panel ceiling installation required to demonstrate aesthetic effects and qualities of materials and execution. The sample installation shall be complete in every way and include all attachments to structure, hangers, grids, ceiling panels, moldings and column trims, light fixtures, air outlets and inlets, speakers, sprinklers heads, heat and smoke detectors. Install sample installations to comply with the following requirements, using materials indicated for the completed Work:

1. Size and Location: Provide 250 square foot (23.23 sq. m) sample installations in locations as directed by Architect.
2. Demonstrate the proposed range of aesthetic effects and workmanship.
3. Obtain Architect's approval of sample installations before starting work.
4. Maintain sample installations during construction in an undisturbed condition as a standard for judging the completed Work.

F. Approved sample installations may become part of the completed Work if undamaged at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until wet work (painting, drywall, interior tilework, and concrete leveling) in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 METAL SUSPENSION SYSTEMS

A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

B. Overhead Deck Hanger Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.

1. Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with eyepins, clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling assembly.

C. Hangers: As follows:

1. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641/A 641M, Class 1 zinc coating, soft temper.

a. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 12 gage (0.106-inch) (2.69-mm) diameter wire.

2. Flat Hangers: Commercial-sheet steel, ASTM A 653/A 653M, G60, hot dip galvanized.

a. Size: 1 by 3/16 inch (25.4 by 9.5 mm) by length indicated.

D. Carrying Channels: ASTM C 754, cold rolled steel channels, 1-1/2-inch (38-mm), 475 pounds (215 kg) per 1000 feet (30.48 m).

E. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners; provide in longest standard single piece lengths.

1. Shadow (Stepped Moldings): Stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member. Form from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.
2. F Moldings: Provide F moldings at ceiling breaks, soffits, bulkheads, and changes in elevation other than vertical walls and columns to the extent indicated. Form from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.
3. Metal Perimeter Channel Trim: Shapes and profiles to suit conditions indicated; fabricated from extruded aluminum; finished to match exposed flanges of suspension system runners. Provide manufacturer's recommended tee-bar connection clips, and hanging clips, which lock into specially designed bosses on the channel trim and are screw attached to the web of the intersecting suspension system members. Join sections of trim together with manufacturer's standard splice plates and alignment clips.
4. Perimeter Wing Trim: Shapes and profiles to suit conditions indicated; fabricated from and finished to match exposed panel. Provide manufacturer's recommended connect wing cantilevers, connect splines, connect hooks, connect multi-connection, and installation screws suitable for installation indicated.

F. Clips: Provide support clips, clamps, fasteners, splines, and other attachment devices as required to align components and to connect components and transfer imposed loads of suspension system.

1. Provide partition attachment clips, and fasteners for areas where partition ceiling runners are secured to the ceiling suspension system.
2. Provide attachment clips for runner to angle molding to avoid use of pop rivets.
3. Provide grid converter accessories as required to change main tee direction 90 degrees from adjacent main tee.
4. Provide light fixture clips.
5. Provide hold down clips at entryways to reduce flutter as required.
6. Provide miter closure clips.
7. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
8. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.

G. Manufacturers and Products: Refer to drawings and schedules for extent and types of each metal suspension system required.

H. Subject to requirements, provide scheduled suspension systems, or comparable products, acceptable to the Architect, by one of the following:

1. Armstrong World Industries, Inc.

2. CertainTeed Corporation.
3. Chicago Metallic Corporation.
4. United States Gypsum Company.

2.2 ACOUSTICAL PANELS (CL##)

A. Manufacturers and Products: Refer to drawings and schedules for extent and types of each acoustical panel required.

B. Subject to requirements, provide scheduled acoustical panels, or comparable products, acceptable to the Architect, by one of the following:

1. Armstrong World Industries, Inc.
2. CertainTeed Corporation.
3. Chicago Metallic Corporation.
4. Rockfon (Roxul Inc.).
5. United States Gypsum Company.

C. 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.

2.3 ACCESSORIES

A. Sealant:

1. Sealant shall have a VOC content of 250 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation, anchorage, with requirements for installation tolerances, and other conditions affecting performance of acoustical panel ceilings.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Layout the Work to center board pattern both directions around Work points shown in each major space or room as shown on the Drawings or directed and, where possible, adjust pattern so that edge pieces will be not less than 1/2 unit in width.

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook," and as required to match the accepted sample installation.

B. Suspend ceiling hangers as follows:

1. Fasten hangers to anchors that extend into decks. Space hangers not more than 48 inches (1200 mm) on center along each member supported directly from hangers; and provide hangers not more than 6 inches (150 mm) from ends of each member. Provide additional hangers for support of fixtures and other items including but not limited to light fixtures and diffusers, as required to prevent overloading of deck attachment, eccentric deflection or rotation of supporting runners.
2. Hangers:

    a. Secure wire hangers to ceiling suspension members and to supports above with a minimum of 3 tight turns. Connect hangers directly to drilled in anchors (eye screws), or other devices that are secure, and are appropriate for substrate.
    b. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to drilled in anchors, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved.

3. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
4. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of the supporting structure or of the ceiling suspension system.
5. 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. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
6. Lateral Force Bracing:

    a. Horizontal restraints shall be provided by four No. 12 gage (2.7 mm) wires secured to the main runner within 2 inches of the cross runner intersection and splayed 90 degrees from each other at an angle not exceeding 45 degrees from the plane of the ceiling. A strut fastened to the main runner shall be extended to and fastened to the structural members supporting the roof or floor above. The strut shall be adequate to resist the vertical component induced by the bracing wires. These horizontal restraint points shall be placed not more than 12 feet (3.65 m) on center in both directions with the first point within 6 feet from each wall. Attachment of the restraint wires to the structure above shall be adequate for the load imposed.

b. Lateral force bracing members shall be spaced a minimum of 6 inches (150 mm) from all horizontal piping or ductwork that is not provided with bracing restraints for horizontal forces. Bracing wires shall be attached to the grid and to the structure in such a manner that they can support a design load of not less than 200 pounds or the actual design load, whichever is greater, with a safety factor of 2.

C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Typical Edge Molding Attachment: Align moldings accurately and screw attach securely to substrate with concealed fasteners at intervals not more than 16 inches (400 mm) on center and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system. Miter corners accurately and connect securely.

a. Do not use exposed fasteners, including pop rivets, on moldings and trim.

2. Window and Curtain Wall Frame Head Attachment: Unless otherwise indicated, align moldings accurately and secure to window and curtain wall frame heads using manufacturer's recommended double-sided foam white tape, leveling with ceiling suspension system. Miter corners accurately and adhere securely.

a. Do not use exposed fasteners, including pop rivets, on moldings and trim.

D. Install suspension system runners so they are square and securely interlocked with one another. Clip runners to angle moldings do not use exposed fasteners. Finish to lines and levels shown, with maximum deflection not to exceed 1/360 of the span between supports. Laser level accurately in all directions, leveling to a tolerance of 1/8-inch (3.18-mm) noncumulative. Remove and replace dented, bent, or kinked members.

E. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Run grain of units in one direction as accepted on shop drawings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
2. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
3. For reveal-edged panels on suspension system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.
4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using sealer and coating recommended in writing for this purpose by acoustical panel manufacturer.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Compliance of seismic design.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.

C. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.

1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.

a. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.
b. 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 and anchors and fasteners will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 13

SECTION 09 61 23 - CONCRETE FLOORING TREATMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes concrete sealing compound for the following applications:

1. Existing concrete floor to remain exposed.

B. Related Requirements:

1. Section 03 30 00 "Cast-in-Place Concrete" for curing and hardening products for new concrete Work.

1.2 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's specifications, VOC content, application instructions, and general recommendations. Include data substantiating that products to be furnished comply with requirements of the contract documents.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: Submit manufacturer's instructions for proper maintenance materials and procedures.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Accessibility Requirements: Comply with applicable provisions of the following:

a. U.S. Architectural and Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities (ADAAG).
b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.

B. Manufacturer Qualifications: Provide products produced by a company that has successfully specialized in production of this type of work for not less than 5 years.

C. Mockups: Apply mockups of each concrete flooring treatment indicated and each color and finish selected to verify color selection 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 concrete flooring treatment specified in Part 2.

    a. Provide samples of at least 48 by 48 inches square (1220 by 1220 mm sq).

2. Final approval of color selections will be based on mockups.

    a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers with seals unbroken and bearing manufacturer's labels.

B. Store materials in a clean, dry location protected from exposure to direct sunlight. In storage areas, maintain environmental conditions within range recommended in writing by manufacturer.

1.6 FIELD CONDITIONS

A. Environmental Requirements: Do not proceed with installation until areas to receive the work have been enclosed and until temperature and relative humidity have been stabilized and will be maintained within values established by the manufacturer for optimum quality control.

B. Environmental Limitations: Comply with coating manufacturer's written instructions for substrate temperature, ambient temperature, humidity, ventilation, and conditions affecting floor treatment application. Do not apply coating until wet work in spaces is complete and dry; and overhead work, including installation of athletic equipment, mechanical systems, and lighting is complete.

    1. Apply floor coatings when substrate temperature and surrounding air temperatures are between 50 deg F and 95 deg F (10 deg F and 35 deg C).

C. Do not apply floor coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

D. Ventilation: Provide adequate ventilation to prevent accumulation of hazardous fumes, if any, during application of concrete floor sealer in enclosed spaces, and maintain ventilation until sealer has cured.

PART 2 - PRODUCTS

2.1 SEALING COMPOUND

A. Clear, Waterborne, Membrane-Forming Sealing Compound: ASTM C 1315, Type 1, Class A or B.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Master Builder Solutions by BASF; MasterKure HD 100WB.
   b. Master Builder Solutions by BASF; MasterKure HD 200WB.
   c. The Euclid Chemical Company; Diamond Clear VOX.
   d. QC Construction Products; QC VOC 100 WB

2. VOC Content: Sealing compounds shall have a VOC content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for conditions affecting performance and conditions of floor treatment with requirements for maximum moisture content. Verify concrete slabs are flat, level, and dry.

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter for concrete: 12 percent.
2. Verify compatibility with and suitability of substrates, including existing finishes or primers. Verify if plasticizers in existing concrete substrate will not impair bond.
3. Perform tests recommended by manufacturer. Proceed with installation after substrates pass testing.
4. Commence coating application after unsatisfactory conditions are corrected and surfaces are dry.
5. Commencement of floor treatment application indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Clean substrate, removing projections and substances detrimental to the work; comply with recommendations of manufacturer for preparation procedures. Mask off or protect adjacent surfaces not scheduled to receive sealer.

B. Concrete Substrates: Prepare and clean substrates according to manufacturer's written instructions.

1. Clean substrates of substances that impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants. Neutralize plasticizers that cannot be removed.
2. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
3. Remove incompatible primers and reprime substrate with compatible primers as required
4. Remove laitance, glaze, curing compounds, form release agents, dust, dirt, grease, oil, and contaminants that impair bond. Remove contaminants using mechanical means.
5. Treat nonmoving substrate cracks and control joints to prevent cracks from telegraphing (reflecting) through flooring according to manufacturer's written recommendations.
6. Protect substrate voids and joints to prevent flooring resins from flowing into or leaking through them.

C. Protect walls, floor openings, equipment inserts, electrical openings, door frames, and obstructions during installation. Cover floor and wall areas at mixing stations.

3.3 APPLICATION

A. General: Comply with manufacturer's instructions, except where more stringent requirements are shown or specified, and except where Project conditions require extra precautions or provisions to ensure satisfactory performance of the Work.

B. Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.4 CLEANING

A. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or appropriate methods for coating. Do not scratch or damage adjacent finished surfaces.

3.5 PROTECTION

A. Institute protective procedures and install protective materials as required to ensure that work is without damage or deterioration at substantial completion. Protect adjacent work against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

B. At completion of construction activities and before Substantial Completion, touch up and restore damaged or defaced coated surfaces.

END OF SECTION **09 61 23**

SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes resilient wall base, and moldings.

1.2 ACTION SUBMITTALS

A. Product Data: Submit product data for each type of product indicated.

B. Samples: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches (300 mm) long, of each resilient product color, texture, and pattern required.

1.3 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. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.4 FIELD CONDITIONS

A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT WALL BASE (RB##)

A. Products and Manufacturers: Johnsonite resilient wall base, or as indicated in Finish Schedule on Drawings. Nominal thickness not less than 1/8 inch (3 mm) unless greater thickness is scheduled. All resilient base shall be manufactured from rubber complying with ASTM F 1861, Type TS (rubber, vulcanized thermoset) or Type TP (rubber, thermoplastic), Group I (solid, homogeneous). Provide all resilient wall base in continuous coils to minimize field butt joints.

B. Provide all resilient wall bases with a coved base toe style typically; and with straight flat or toeless base style at carpet, unless otherwise indicated in Finish Schedule on Drawings.

2.2 RESILIENT MOLDING ACCESSORY

A. Description: Reducer strip for resilient floor covering.

B. Material: Rubber.

C. Profile and Dimensions: As indicated on the Drawings.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based formulation provided or approved by resilient product manufacturers for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

1. Adhesives shall have a VOC content of 50 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.

B. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

1. Do not install resilient products until they are the same temperature as the space where they are to be installed.

3.3 RESILIENT WALL BASE INSTALLATION

A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

D. Do not stretch wall base during installation.

E. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.

F. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.
2. Inside Corners: Use straight pieces of maximum lengths possible. Form by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Remove adhesive and other blemishes from exposed surfaces.

B. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

    a. Do not wash surfaces until after time period recommended by manufacturer.

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. Use protection methods recommended in writing by manufacturer.

END OF SECTION 09 65 13

SECTION 09 65 66 - RESILIENT ATHLETIC FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rubber sheet flooring.

B. Related Sections:

1. Section 09 65 13 "Resilient Base and Accessories" for wall base and accessories installed with flooring.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show installation details and locations of the following:

1. Floor patterns.
2. Locations of floor inserts for athletic equipment installed through flooring.
3. Seam locations for sheet flooring.

C. Samples for Verification: For each type, color, and pattern of flooring indicated, 6-inch-(150-mm-) square Samples of same thickness and material indicated for the Work.

1. Seam Samples: For each vinyl sheet flooring color and pattern required; with seam running lengthwise and in center of 6-by-9-inch (150-by-230-mm) Sample applied to a rigid backing and prepared by Installer for this Project.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified sheet vinyl flooring Installer.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For flooring to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sheet Flooring: Furnish full-width rolls of not less than 10 linear feet (3 linear m) for each 500 linear feet (150 linear m) or fraction thereof, of each type, color, and pattern of flooring installed.

1.6 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 storing.

B. Store materials to prevent deterioration. Store .

1.7 FIELD CONDITIONS

A. Adhesively Applied Products:

1. Maintain temperatures during installation within range recommended in writing by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive flooring 48 hours before installation, during installation, and 48 hours after installation unless longer period is recommended in writing by manufacturer.
2. After postinstallation period, maintain temperatures within range recommended in writing by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
3. Close spaces to traffic during flooring installation.
4. Close spaces to traffic for 48 hours after flooring installation unless manufacturer recommends longer period in writing.

B. Install flooring after other finishing operations, including painting, have been completed.

1.8 COORDINATION

A. Coordinate layout and installation of flooring with floor inserts for gymnasium equipment.

1.9 WARRANTY

A. PLAE warrants that Achieve, when installed using its recommended procedures and adhesives, shall be free of manufacturing defects under normal use for a period of 15 years from the date of its original installation.

PART 2 - PRODUCTS

2.1 RUBBER SHEET FLOORING

A. Basis-of-Design Product: Subject to compliance with requirements, provide PLAEAchieve product indicated on Drawings.

B. Description: Rubber athletic flooring provided as rolled goods for adhered installation.

C. Material: Rubber wear layer and rubber shock-absorbent layer, vulcanized together. Recycled SBR rubber and EPDM rubber granules bound by polyurethane.

D. Traffic-Surface Texture: Smooth.

E. Roll Size: Not less than 48 inches (1219 mm) wide by longest length that is practical to minimize splicing during installation.

F. Thickness: 13 mm. 3 mm EPDM wear layer and 10 mm PLAETech underlayment.

G. Color and Pattern: As selected by Architect from manufacturer's full range.

2.2 ACCESSORIES

A. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by flooring manufacturer.

B. Adhesives: Water-resistant type recommended in writing by manufacturer for substrate and conditions indicated. 2 part urethane adhesive.

1. Adhesives shall have a VOC content of 60 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of flooring.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Alkalinity Testing: Perform pH testing according to ASTM F 710. Proceed with installation only if pH readings are not less than 7.0 and not greater than 8.5.
3. Moisture Testing:

    a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.

        1) Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than two tests in each installation area and with test areas evenly spaced in installation areas.

    b. Perform relative humidity test using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by manufacturer. Do not use solvents.

D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

E. Move flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation unless manufacturer recommends a longer period in writing.

1. Do not install flooring until they are same temperature as space where they are to be installed.

F. Sweep and vacuum clean substrates to be covered by flooring immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust.

G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 FLOORING INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions.

B. Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.

C. Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.

D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on flooring. Use nonpermanent, nonstaining marking device.

3.4 SHEET FLOORING INSTALLATION

A. Unroll sheet flooring and allow it to stabilize before cutting and fitting.

B. Lay out sheet flooring as follows:

1. Maintain uniformity of flooring direction.
2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches (150 mm) away from parallel joints in flooring substrates.
3. Match edges of flooring for color shading at seams.
4. Locate seams per approved Shop Drawings.

C. Adhered Flooring: Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.

1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.5 CLEANING AND PROTECTING

A. Perform the following operations immediately after completing flooring installation:

1. Remove adhesive and other blemishes from flooring surfaces.
2. Sweep and vacuum flooring thoroughly.
3. Damp-mop flooring to remove marks and soil after time period recommended in writing by manufacturer.

B. Protect flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

1. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 09 65 66

SECTION 09 68 13 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes carpet tile.

B. Related Requirements:

1. Section 03 30 00 "Cast-In-Place Concrete" for new concrete slabs to receive tile carpeting.
2. Section 03 54 16 "Hydraulic Cement Underlayment" for patching and leveling of substrates

1.2 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

1. The Carpet and Rug Institute "The Carpet Specifiers' Handbook."
2. The Carpet and Rug Institute "CRI 104; Standard for Installation of Commercial Carpet, edition Sept. 2015" (CRI 104).

1.3 PRE-INSTALLATION MEETINGS

A. Pre-Installation 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.

B. Prior to the installation, and at the Contractor's direction, meet at the project site to review the material selections, substrate preparations, installation procedures, coordination with other trades, special details and conditions, standard of workmanship, and other pertinent topics related to the Work. The meeting shall include the Owner, Architect, the Contractor, the installer, material manufacturer's representatives, and representatives of other trades or subcontractors affected by the installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each product indicated, submit product data, specifications, installation instructions for materials specified herein and other data as may be required to show compliance with the Contract Documents. Include installation recommendations for each type of substrate required.

B. Shop Drawings: Show 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, direction, and starting points per floor.
6. Pattern type and location.
7. Type, color, and location of insets and borders.
8. Type, color, and location of edge, transition, and other accessory strips.
9. Pile direction.
10. Transition and other accessory strips.
11. Transition details to other flooring materials.

C. Samples: For each of the products showing full range of color, texture, and pattern variations expected. Prepare samples from same material to be used for the Work. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in Schedules. Submit the following:

1. Carpet Tile: Full-size Samples.
2. Exposed Edge Stripping and Accessory: 12 inch (300 mm) long Samples.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field Test Reports: Provide signed field test reports for tests indicated below. Indicate results and test locations. Include manufacturer's recommendations.

1. Anhydrous calcium chloride test results.
2. Relative humidity probe test results.
3. Alkalinity test results.

C. Warranty: Submit special warranties specified in this Section.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Submit copies of instructions for care, cleaning, maintenance and repair of carpet tiles.

1. Each carpet manufacturer shall meet with the authorized Building Services personnel in the presence of the Owner, to review the characteristics of the carpet tile, and to recommend appropriate maintenance procedures, prior to occupancy of the finished spaces.
2. Include methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
3. Include precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Materials: Furnish extra materials described below before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Engage a carpet installer, who has completed a minimum of three projects over the last 10 years which were similar in material, design and extent to that indicated for the Project - as determined by the Architect - and which have resulted in construction with a record of successful in service performance.

1. In the case where the Installer is actually a Dealer, it is understood that the terms Installer, Dealer, Carpeting Contractor and Contractor shall be one and the same for purposes of this Contract. Installer shall assume responsibility for all of the work, including acquisition of the materials from the manufacturers herein specified.

B. Mill Inspection: The carpeting may be inspected to determine compliance with the Contract Documents with respect to manufacture, materials, pattern and colors. Inspection may be made at the mill by a representative of the Architect and/or Owner at any time during the process of manufacture.

C. Sample Installations: Before installing carpet, install sample installation, for each type of carpet installation required to demonstrate aesthetic effects and qualities of materials and execution. Install sample installations to comply with the following requirements, using materials indicated for the completed Work:

1. Size and Location: Provide 250 square foot (23.23 sq.m) sample installation in location as directed by Architect.
2. Demonstrate the proposed range of aesthetic effects and workmanship.
3. Obtain Architect's approval of sample installations before starting work.
4. Maintain sample installations during construction in an undisturbed condition as a standard for judging the completed Work.
5. Approved sample installations may become part of the completed Work if undamaged at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104.

B. Deliver carpeting in original mill protective wrapping with mill register numbers and tags attached.

C. Deliver other materials in manufacturer's unopened containers identified with name, brand, type, grade, class, and other qualifying information.

D. Store materials in a dry location, in such a manner as to prevent damage.

1.10 FIELD CONDITIONS

A. General: Comply with CRI 104, Section 7.0 "Site Conditions."

B. Environmental Limitations: Do not deliver or install carpet tile until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during remainder of construction.

C. Do not install carpet tile 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.

1.11 WARRANTY

A. Special Carpet Manufacturer's Warranty: Written warranty, signed by carpet tile manufacturer agreeing to replace carpet tile that does not comply with requirements or that fails within specified warranty period. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, wear, static buildup in excess of 3.0 kV when tested under the Standard Shuffle Test at 70 deg F (21 deg C) and 20 percent RH, edge raveling without seam sealers, tuft bind loss, zippering (wet or dry), shrinkage, curling, doming, snags, runs, and delamination. Warrantees shall be full term, not pro-rated for the specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Special Carpet Tile Installer's Warranty: Written warranty, signed by carpet tile installer agreeing to fix, repair or replace carpet tile that does not comply with requirements or that fails within specified warranty period. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than edge raveling, shrinkage, curling, doming, and delamination.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE (CP##)

A. Carpet Tile Types: Provide manufacturer's commercial grade carpet tile for 100 percent glue-down installation as indicated in Finish Schedule on Drawings.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Portland cement-based formulation provided by or recommended by carpet tile manufacturer. Do not use gypsum based compounds.

B. Adhesives: Water-resistant, mildew-resistant, and nonstaining, pressure sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for intended carpet tile, and recommended by manufacturer for releasable installation.

1. VOC Limits: Provide adhesives with VOC content not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Carpet Edging: Provide rubber composition carpet edging in single lengths wherever possible, keeping the number of joints or splices to a minimum. Provide in quantities and locations as job required based upon the recommended good practice of the industry; include in every location where carpet terminates and other flooring continues. Color to match adjacent carpet types.

D. Floor Sealer: Type as recommended and manufactured by the carpet tile manufacturer for the applications indicated.

1. VOC Limits: Provide floor sealer with VOC content not more than 200 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
2. Subfloor finishes comply with requirements specified in Section 03 30 00 "Cast-in-Place Concrete" for slabs receiving carpet tile.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI 104, Section 8.0 "Substrate Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Coordinate the installation of carpet so as not to delay the occupancy of the site or interfere with the completion of construction.

C. Examine the substrates, adjoining construction and the conditions under which the Work is to be installed. Verify recommended limits for moisture content and alkalinity of concrete substrates with carpet manufacturer.

1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. (304.8 sq. m), 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 F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

2. Alkalinity Test: Verify alkalinity of concrete substrates by drilling a 3/8 inch (9.5 mm) diameter hole approximately 1/4 inch (6.35 mm) deep, remove all residue; fill with distilled water, allow water to stand 3 minutes and test with a calibrated electronic meter or pH paper. Perform testing at a frequency of not less than once every 1,000 square feet (93 sq.m).
3. Alternative test procedures for moisture content and alkalinity may be acceptable subject to the carpet manufacturer's review and written acceptance.

D. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Provide one of the following:

   a. Remove coatings, including curing compounds, existing floor covering adhesive residues, 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 the carpet manufacturer.
   b. In lieu of mechanical substrate preparation methods, the Contractor may utilize floor sealer materials and methods of the types and methods as recommended, in writing, by the carpet tile manufacturer. Apply sealer in number of coats, and at the spread rate, as required by the carpet tile manufacturer.

2. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by the carpet tile manufacturer.
3. Use leveling and patching compounds recommended by flooring manufacturer for filling cracks, holes and depressions in the substrate. Surface shall be smooth, level and at proper elevation. Remove ridges, roughness and protrusions from concrete surfaces by grinding.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet.

F. Carpet installation shall not commence until painting and finishing work are complete and ceiling and overhead work is tested, approved, and completed.

G. Proceed with installation only after unsatisfactory conditions have been corrected

3.3 INSTALLATION

A. General: Comply with CRI 104, Section 10.0 "Carpet Tile Installation," carpet tile manufacturer's written installation instructions, and as required to match the accepted sample installations. Apply adhesive in accordance with adhesive manufacturer's directions.

B. Adhere all full size, perimeter tiles, and cut tiles, with a full spread of adhesive. Dry fit cut tiles and apply adhesive to tile back after tile has been cut. Use full uncut tiles down the center of corridors and, where necessary, cut perimeter tiles to butt walls.

1. 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.
2. Cut openings in carpet for electrical outlets, piping and other penetrations. Maintain close tolerances so that edges of carpet will be covered by plates and escutcheons.
3. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

C. Butt carpet tile tightly together to form seams without gaps or entrapped pile yarns and aligned with adjoining tiles.

D. Edge Strip Installation: Install edge strip at every location where edge of carpet is exposed to traffic, unless otherwise indicated. Unless otherwise directed by Architect install in single lengths and secure in accordance with manufacturer's directions.

E. Traffic over adhesive installations shall be restricted until adhesive has properly cured in accordance with the adhesive manufacturer's recommendations.

3.4 CLEANING AND PROTECTION

A. Cleaning: As the carpeting is installed, remove and dispose of all trimmings, excess pieces of carpeting and laying materials from each area as it is completed. Vacuum carpeting with a commercial vacuum, having a cylindrical brush or beater bar and high suction. Remove adhesives, stains, and soil spots in accordance with the carpet manufacturer's recommendations.

B. Protection: Protect installed carpet tile to comply with CRI 104, Section 11.0 "Post Installation," and against damage as damaged carpeting shall be rejected. Use non-staining cover material for protection. Tape joints of protective covering.

1. Plastic and polyethylene sheet protective coverings shall not be permitted.
2. Remove and replace rejected carpeting with new carpet tile. At the completion of the Work and when directed by the Architect, remove covering, vacuum clean carpeting and remove soiling and stains (if any) to the satisfaction of the Architect.

END OF SECTION 09 68 13

SECTION 09 68 16 - TURF FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes PLAE Attack Synthetic Turf Attack Rolls.

B. Related Requirements:

1. Section 03 54 16 "Hydraulic Cement Underlayment" for patching and leveling of substrates

1.2 PRE-INSTALLATION MEETINGS

A. Pre-Installation Conference: Conduct conference at Project site.

1. Review methods and procedures related to turf flooring 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.

1.3 ACTION SUBMITTALS

A. Product Data: Submit product data, specifications, installation instructions for materials specified herein and other data as may be required to show compliance with the Contract Documents. Include installation recommendations for each type of substrate required.

B. Shop Drawings: Submit shop drawings showing the following:

1. Existing floor materials to be removed.
2. Existing floor materials to remain.
3. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in turf flooring.
4. Dye lots, pattern types, repeats, locations, pile direction, and starting points per floor.
5. Seam locations, types, and methods.
6. Type of subfloor.
7. Type of installation.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Show details of cutouts.
11. Include on shop drawings dimensions which verify field conditions.
12. Transition, and other accessory strips.

13. Transition details to other flooring materials.

C. Samples: Submit samples showing full range of color, texture, and pattern variations expected. Prepare samples from same material to be used for the Work. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in Schedules. Submit the following:

1. Turf Flooring: 24 inch (600 mm) square Samples of each turf flooring required.
2. Exposed Edge Stripping and Accessory: 12 inch (300 mm) long Samples.

1.4 INFORMATIONAL SUBMITTALS

A. Field Test Reports: Provide signed field test reports for tests indicated below. Indicate results and test locations. Include manufacturer's recommendations.

1. Anhydrous calcium chloride test results.
2. Relative humidity probe test results.
3. Alkalinity test results.

B. Warranties: Submit special warranties specified in this Section.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: Submit copies of instructions for care, cleaning, maintenance and repair of turf flooring.

1. Each turf flooring manufacturer shall meet with the authorized Building Services personnel in the presence of the Owner, to review the characteristics of his product and to recommend appropriate maintenance procedures, prior to occupancy of the finished spaces.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Materials: Furnish extra materials described below before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Truf Flooring: Full-width rolls equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

B. Attic Stock: Package and deliver usable remnants of turf flooring to the Owner's storage room as directed by the Owner at the conclusion of the job. Include pieces 20 square feet (1.86 sq.m) in area or greater.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Engage a turf flooring installer, who has completed a minimum of three projects over the last 10 years which were similar in material, design and extent to that indicated for the Project –Ó as determined by the Architect –Ó and which have resulted in construction with a record of successful in service performance.

1. In the case where the Installer is actually a Dealer, it is understood that the terms Installer, Dealer, Turf Flooring Contractor and Contractor shall be one and the same for purposes of this Contract. He shall assume responsibility for all of the work, including acquisition of the materials from the manufacturers specified.

B. Mill Inspection: The turf flooring may be inspected to determine compliance with the Contract Documents with respect to manufacture, materials, pattern and colors. Inspection may be made at the mill by a representative of the Architect and/or Owner at any time during the process of manufacture.

C. Fire-Test-Response Ratings: Where indicated, provide turf flooring identical to those of assemblies tested for fire response per NFPA 253 by a qualified testing agency.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104.

B. Deliver turf flooring in original mill protective wrapping with mill register numbers and tags attached.

C. Deliver other materials in manufacturer's unopened containers identified with name, brand, type, grade, class, and other qualifying information.

D. Store materials in a dry location, in such a manner as to prevent damage.

1.9 FIELD CONDITIONS

A. General: Comply with CRI 104, Section 7.0 "Site Conditions."

B. Environmental Limitations: Do not deliver or install turf flooring until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

C. Do not install turf flooring over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and concrete slabs have pH range recommended by turf flooring manufacturer.

1.10 WARRANTY

A. Special Turf Flooring Manufacturer's Warranty: Written warranty, signed by turf flooring manufacturer agreeing to replace turf flooring that does not comply with requirements or that fails within specified warranty period. Warranty does not include deterioration or failure of turf flooring due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, wear, static buildup in excess of 3.0 kV when tested under the Standard Shuffle Test at 70 deg F (21 deg C) and 20 percent RH, edge raveling, tuft bind loss, shrinkage, zippering (wet or dry), excess static discharge, and delamination. Warrantees shall be full term, not pro-rated for the specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Installation Warranty: Submit copies of written warranty signed by the turf flooring installer and Contractor, warranting the turf flooring installation, for a period of two years, that the turf flooring will not tear, crack, separate, deteriorate or pull loose from substrate, or experience seam failure, ripples, scallops, pilling or puckering.

PART 2 - PRODUCTS

2.1 TURF FLOORING(CP<##>)

A. Turf Flooring Types: Provide PLAE Attack consisting of 14 mm Fiber Pile Height with a 5 mm Urethane Foam Backing 100% glue-down installation as indicated in Finish Schedule on Drawings.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Portland cement based formulation provided by or recommended by the following. Do not use gypsum based compounds.

1. Turf Flooring manufacturer.

B. Turf Flooring Adhesives: Water-resistant, mildew resistant, and nonstaining, high solids, low VOC emitting formulations that are specifically recommended by the turf flooring manufacturer, as verified through compatibility and adhesion testing for the intended substrate and application, and that comply with flammability requirements for installed turf flooring: two part urethane adhesive.

1. VOC Limits: Provide adhesives with VOC content not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).

C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edge of turf flooring, and of maximum lengths to minimize running joints.

D. Edging: Provide rubber composition edging in single lengths wherever possible, keeping the number of joints or splices to a minimum. Provide in quantities and locations as job required based upon the recommended good practice of the industry; include in every location where turf flooring terminates and other flooring continues. Color to match adjacent turf flooring types.

E. Floor Sealer: Type as recommended and manufactured by the turf flooring manufacturer for the applications indicated.

1. VOC Limits: Provide floor sealer with VOC content not more than 200 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).

PART 3 - EXECUTION

3.1 PRE-INSTALLATION MEETING

A. Prior to the installation, and at the Contractor's direction, meet at the Project site to review the material selections, substrate preparations, installation procedures, coordination with other trades, special details and conditions, standard of workmanship, and other pertinent topics related to the Work. The meeting shall include the Owner, Architect, the Contractor, the installer, material manufacturer's representatives, and representatives of other trades or subcontractors affected by the installation.

3.2 PREPARATION

A. General: Comply with CRI 104, Section 8.0 "Substrate Preparation," and with turf flooring manufacturer's written installation instructions for preparing substrates.

B. Coordinate the installation of turf flooring so as not to delay the occupancy of the site or interfere with the completion of construction.

C. Examine the substrates, adjoining construction and the conditions under which the Work is to be installed. Verify recommended limits for moisture content and alkalinity of concrete substrates with turf flooring manufacturer.

1. Moisture Content: Verify moisture content using a standard calcium chloride crystal test or a 1 square yard (0.84 sq.m) clear plastic test. Perform testing at a frequency of not less than once every 1,000 square feet (93 sq.m).
2. Alkalinity Test: Verify alkalinity of concrete substrates by drilling a 3/8 inch (9.5 mm) diameter hole approximately 1/4 inch (6.35 mm) deep, remove all residue; fill with distilled water, allow water to stand 3 minutes and test with a calibrated electronic meter or pH paper. Perform testing at a frequency of not less than once every 1,000 square feet (93 sq. m).
3. Alternative test procedures for moisture content and alkalinity may be acceptable subject to the turf flooring manufacturer's review and written acceptance.

D. Concrete Subfloors: Verify that concrete slabs comply with the following:

1. Provide one of the following:

a. Remove coatings, including curing compounds, existing floor covering adhesive residues, 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 the turf flooring manufacturer.
b. In lieu of mechanical substrate preparation methods the Contractor may utilize floor sealer materials and methods of the types and methods as recommended, in writing, by the turf flooring manufacturer. Apply sealer in number of coats, and at the spread rate, as required by the turf flooring manufacturer.

2. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by the turf flooring manufacturer.
3. Use leveling and patching compounds recommended by flooring manufacturer for filling cracks, holes and depressions in the substrate. Surface shall be smooth, level and at proper elevation. Remove ridges, roughness and protrusions from concrete surfaces by grinding.

E. Broom and vacuum clean substrates to be covered immediately before installing turf flooring.

F. Turf flooring installation shall not commence until painting and finishing work are complete and ceiling and overhead work is tested, approved, and completed.

G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. 100 Percent Direct Glue Down of Turf Flooring: Comply with the manufacturer's instructions, CRI 104, Section 13.0 "Direct Glue-Down," and as required to match the accepted sample installations.

1. Layout, Cutting and Edge Trim Seaming: Prior to applying adhesives, place seams at locations indicated on accepted shop drawings. All rolls shall be installed in the exact roll number sequence as listed on the rolls. Maintain direction of pattern, texture and lay of pile. Side to end seaming shall not be allowed. All edges of all rolls shall be finish trimmed prior to laying to assure a perfect seam condition and turf flooring match. All trimmed edges shall then be treated with latex seaming adhesive to assure that loose and cut yarns are not left to ravel or pull out.

a. Cut and fit turf flooring 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 manufacturer.

b. Extend turf flooring into closets and offsets, and under movable equipment of the rooms and spaces shown or scheduled to receive turf flooring, including recessed covers within those spaces.
c. Provide cutouts as required for removable access covers in substrates except do not cutout for floor closer cover plates. Bind edges neatly and secure to substrate. Cut only 3 sides wherever it is feasible to provide flap in lieu of fully removable cutout.
d. At doorways, center seams under door in closed position; do not place seams perpendicular to door frame in direction of traffic through doorway.
e. Cut openings in turf flooring for electrical outlets, piping and other penetrations. Maintain close tolerances so that edges of turf flooring will be covered by plates and escutcheons.
f. Seams shall be located away from areas subject to pivoting traffic.

2. Apply adhesive in accordance with adhesive manufacturer's directions.
3. Adhere turf flooring with a full spread of adhesive. Ensure uniform bond over the entire area.

a. Butt turf flooring tightly together to form seams without gaps or entrapped pile yarns and aligned with adjoining rolls. Seams shall be pressed by hand and/or suitable tool to produce the best possible even top pile width-to-width. Adjacent widths of turf flooring must be installed to finish at exactly the same elevation.
b. Roll turf flooring uniformly, removing air pockets and bubbles.
c. If the pile has been compressed while laying in storage, so that there appears to be a difference in color in adjacent widths of material, the Contractor shall neutralize the pile with a steam machine and obtain a uniform pile direction throughout by brushing the turf flooring while it is still damp, at no additional cost to the Owner.

4. Edge Strip Installation: Install edge strip at every location where edge of turf flooring is exposed to traffic, unless otherwise indicated. Unless otherwise directed by Architect install in single lengths and secure in accordance with manufacturer's directions.
5. Traffic over adhesive installations shall be restricted until adhesive has properly cured in accordance with the adhesive manufacturer's recommendations.

3.4 CLEANING AND PROTECTION

A. Cleaning: As the turf flooring is installed, remove and dispose of all trimmings, excess pieces of turf flooring and laying materials from each area as it is completed. Vacuum turf flooring with a commercial vacuum, having a cylindrical brush or beater bar and high suction. Remove adhesives, stains, and soil spots in accordance with the turf flooring manufacturer's recommendations.

B. Protection: Protect turf flooring against damage of every kind as damaged turf flooring shall be rejected. Use non-staining cover material for protection. Tape joints of protective covering.

1. Plastic and polyethylene sheet protective coverings shall not be permitted over glue down installations.

2. Remove and replace rejected turf flooring with new turf flooring. At the completion of the work and when directed by the Architect, remove covering, vacuum clean turf flooring and remove soiling and stains (if any) to the satisfaction of the Architect.

END OF SECTION 09 68 16

SECTION 09 91 23 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and field application of paint systems on the following interior substrates:

1. Concrete.
2. Concrete masonry units (CMU).
3. Gypsum board.
4. Steel.
5. Galvanized metal.
6. Aluminum (not anodized or otherwise coated).
7. Aluminum (anodized).
8. Aluminum (powder-coated).
9. Wood and hardboard.
10. Rubber.

1.2 DEFINITIONS

A. General: The following terms apply to this Section. Gloss level shall be determined according to ASTM D 523.

1. Gloss Level 1(Flat, or Matte): Not more than 5 units at 60 degrees and 10 units at 85 degrees.
2. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees.
3. Gloss Level 3 (Eggshell): 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees.
4. Gloss Level 4 (Satin or Low Luster): 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees.
5. Gloss Level 5 (Semigloss): 35 to 70 units at 60 degrees.
6. Gloss Level 6 (Gloss): 70 to 85 units at 60-degrees.
7. Gloss Level 7 (High Gloss): More than 85 units at 60 degrees.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat, with texture to simulate actual conditions.

1. Provide stepped Samples, defining each separate coat, including primers. Use representative colors when preparing Samples for review. Resubmit until required gloss, color, and texture are achieved.
2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
3. Submit paint samples on actual substrate to be painted, 12 inches (305 mm) square, of each color and texture required.

C. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. VOC content.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 1 gal. (3.8 L) of each material and color applied.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Sample Installation: Apply sample installation of each paint system indicated and each color and finish selected 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. (9 sq. m).
   b. Other Items: Architect will designate items or areas required.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in sample installations unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved sample installations may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Benjamin Moore Family of Products (Benjamin Moore, Coronado, Corotech, Insl-x, LenMar)
2. PPG Paints (PPG)
3. Sherwin-Williams Co. (SW)
4. Vista Paint Corporation (Vista)

B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles for the paint category indicated.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers.

2.2 PAINT, GENERAL (PT##)

A. Material Compatibility: Provide materials for use within each paint system that are compatible with one another and with the substrates indicated, under conditions of service and application, as demonstrated by manufacturer based on testing and field experience. 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: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: VOC content of not more than 50 g/L.
2. Nonflat Paints and Coatings: VOC content of not more than 100 g/L.
3. Dry Fog Coatings: VOC content not more than 150 g/L.
4. Primers, Sealers, and Undercoaters: VOC content not more than 100 g/L.

5. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC content not more than 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: VOC content not more than 340 g/L.
7. Pre-Treatment Wash Primers: VOC content not more than 420 g/L. Floor Coatings: VOC content not more than 100 g/L.
8. Shellacs, Clear: VOC content not more than 730 g/L.
9. Shellacs, Pigmented: VOC content not more than 550 g/L.

C. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

D. Colors and Gloss: As indicated in Finish Schedule on Drawings. Reference to a particular manufacturer's number or color name is used only as a convenience for the Architect in order to establish the Project color and gloss requirements. These references are not intended to describe the required generic paint systems. For generic paint system requirements, refer to the "Interior Paint Schedule" at the end of Part 3, as applicable to the respective conditions of use.

1. The selection of paint colors and gloss are indicated by manufacturer and color type; designated as "PT##."
2. Furnish the same lots, batches, etc. within the same contiguous areas of the building (i.e., corridors on the same floors, common rooms which adjoin each other, etc.).

2.3 PREPARATORY COATS

A. CMU Block Filler:

1. Benjamin Moore; Coronado Super Kote 5000 Latex Block Filler (958-11).
2. PPG; Speedhide Interior/Exterior Masonry Latex Block Filler (6-7).
3. SW; PrepRite Block Filler Interior/Exterior Latex (B25W25).

B. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.

C. Primer Sealer, Latex, Interior:

1. Benjamin Moore; Ultra Spec 500 Interior Latex Primer (N534).
2. PPG; Speedhide Zero Interior Latex Sealer Quick-Drying (6-4900).
3. SW; ProMar 200 Zero VOC Interior Latex Primer (B28W02600).

D. Primer, Alkali Resistant, Water Based:

1. Benjamin Moore; Super Spec Masonry Int/Ext Acrylic High Build Primer (N068).
2. PPG; Perma-Crete Interior/Exterior Alkali-Resistant Primer (4-603).
3. SW; Loxon Concrete & Masonry Primer Interior/Exterior Latex (A24W8300).

E. Primer, Latex, for Interior Wood:

1. Benjamin Moore; Ultra Spec 500 Interior Latex Primer (N534).
2. PPG; SEAL GRIP Interior Primer/Finish (17-951).
3. SW; Premium Wall & Wood Interior Latex Primer (B28W08111).

F. Primer, Bonding, Water Based:

1. Benjamin Moore; Insl-x Stix Bonding Primer (SXA-110).
2. PPG; SEAL GRIP Interior/Exterior Acrylic Universal Primer/Sealer (17-921).
3. SW; Adhesion Primer Interior/Exterior Latex (B51W8050).

G. Primer, Acrylic:

1. Benjamin Moore; Super Spec HP Acrylic Metal Primer (P04).
2. PPG; Pitt Tech Interior/Exterior Primer/Finish DTM Industrial Primer (90-712).
3. SW; Pro Industrial Pro-Cryl Universal Primer (B66-310 Series).

H. Where manufacturer does not recommend a separate primer formulation on substrate indicated, use paint specified for finish coat.

2.4 WATER-BASED PAINTS

A. Latex, Interior, Gloss Level 1 (Flat):

1. Benjamin Moore; Ultra Spec 500 Interior Flat (N536).
2. PPG; SPEEDHIDE zero Interior Zero-VOC Latex Flat (6-4110XI).
3. SW; ProMar 200 Zero VOC Interior Latex Flat (B30-2600 Series).

B. Latex, Interior, Gloss Level 3 (Eggshell).

1. Benjamin Moore; Ultra Spec 500 Interior Eggshell (N538).
2. PPG; SPEEDHIDE zero Interior Zero-VOC Latex Eggshell (6-4310XI).
3. SW; ProMar 200 Zero Interior VOC Latex Eg-Shel (B20-2600 Series).

C. Latex, Interior, Gloss Level 5 (Semigloss):

1. Benjamin Moore; Ultra Spec 500 Interior Semi-Gloss (N539).
2. PPG; SPEEDHIDE zero Interior Zero-VOC Latex Semi-Gloss (6-4510XI).
3. SW; ProMar 200 Zero VOC Latex Semi-Gloss (B31-2600 Series).

D. Latex, Interior, High Performance Architectural, Gloss Level 3 (Eggshell):

1. Benjamin Moore; Corotech PreCatalyzed Waterborne Epoxy Eggshell V342.
2. PPG; Pitt-Glaze WB1 Interior Eggshell Pre-Catalyzed Water-Borne Acrylic Epoxy (16-310).
3. SW; Pro Industrial Pre-Catalyzed Waterbased Epoxy Eg-Shel (K45W1150 Series).

E. Latex, Interior, High Performance Architectural, Gloss Level 5 (Semigloss):

1. Benjamin Moore; Corotech PreCatalyzed Waterborne Epoxy SG (V341).
2. PPG; Pitt-Glaze WB1 Interior Semi-Gloss Pre-Catalyzed Water-Borne Acrylic Epoxy (16-510).
3. SW; Pro Industrial Pre-Catalyzed Waterbased Epoxy Semi-Gloss (K46W1150 Series).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with manufacturer's requirements for paint application. Comply with procedures specified in PDCA P4.

1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.

3.2 PREPARATION

A. Remove hardware and hardware accessories, cover plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible, provide surface-applied protection before surface preparation and painting.

B. Before applying paint or other surface treatments, clean substrates of substances that could impair bond of paints. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified. Provide barrier coats over incompatible primers or remove and reprime.

1. Concrete Substrates: Remove release agents, curing compounds, hardeners, sealers, 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.

    a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.

2. CMU 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.
3. Gypsum Wallboard: Repair all surfaces in gypsum wallboard with wallboard joint finishing compound or spackling compound, filled out flush and sanded smooth. Clean all surfaces and taped joints of dust, dirt and other contaminants and be sure they are thoroughly dry before applying paint.

4. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
5. 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.
6. 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.
7. Aluminum Substrates: Remove loose surface oxidation.
8. Anodized Aluminum Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates. Abrade surface to promote adhesion of subsequently applied paints.
9. Powder-Coated Aluminum Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates. Abrade surface to promote adhesion of subsequently applied paints.
10. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

    a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
    b. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.

11. Rubber: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates. Abrade surface to promote adhesion of subsequently applied paints, if necessary.

D. Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

E. Tint each undercoat a lighter shade to facilitate identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

A. Apply block fillers to CMU at a rate to ensure complete coverage with pores filled.

B. Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors, surface treatments, and finishes are indicated in Finish Schedule on Drawings.
2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
3. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
4. Extend coatings in exposed surfaces, as required, to maintain system integrity and provide desired protection.

    a. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place.

5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
6. Paint front and back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces. Paint access panels, electrical panels, air diffusing outlets, supply and exhaust grilles, louvers, exposed conduit, primed hardware items, primed outlet covers, primed wall and ceiling cover plates and other items in painted areas to match the areas in which they occur unless otherwise directed by the Architect.

C. Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.

    a. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
    b. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
    c. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

2. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

D. Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

E. 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.

F. Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

G. 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 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.
    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.

    a. Color: Flat (gloss level 1), nonspecular, black.

H. Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 MARKING AND IDENTIFICATION

A. Mark fire-rated and smoke-rated partitions required to have protective openings or penetrations.

1. Locate markings in accessible concealed floor, floor-ceiling, or attic spaces.
2. Provide markings within 15 feet (4572 mm) of the end of each wall and at intervals not exceeding 30 feet (9144 mm) measured horizontally along the partition.
3. Marking shall include stenciled lettering not less than 3 inches (76 mm) in height with a minimum 3/8 inch (9.5 mm) stroke.
4. Apply markings in a contrasting color with the suggested wording "FIRE AND/OR SMOKE BARRIER---PROTECT ALL OPENINGS", or other wording as approved by the Authority Having Jurisdiction.

B. Mark sound-rated partitions as follows:

1. Locate markings in accessible concealed floor, floor-ceiling, or attic spaces.
2. Provide markings within 15 feet (4572 mm) of the end of each wall and at intervals not exceeding 30 feet (9144 mm) measured horizontally along the partition.
3. Marking shall include stenciled lettering not less than 3 inches (76 mm) in height with a minimum 3/8 inch (9.5 mm) stroke.
4. Apply markings in a contrasting color with the suggested wording "STC 45 PARTITION---PROTECT ALL OPENINGS", or other wording as approved by the Owner.

3.5 CLEANING

A. At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.

B. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

C. After completing painting operations in each space or area, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection, if any.

3.6 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage from paint application. Correct damage to work of other trades by cleaning, repairing or replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.7 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates:

1. Latex System:

   a. Primer: Alkali resistant, water based.
   b. Intermediate Coat: Latex, interior, matching topcoat.
   c. Topcoat: Latex, interior (gloss as indicated in Finish Schedule).

2. High-Performance Architectural Latex System:

   a. Primer: Alkali resistant, water based.
   b. Intermediate Coat: Latex, interior, high performance architectural; matching topcoat.
   c. Topcoat: Latex, interior, high performance architectural (gloss as indicated in Finish Schedule).

B. CMU Substrates:

1. Latex System:

   a. Primer: CMU block filler.
   b. Intermediate Coat: Latex, interior, matching topcoat.
   c. Topcoat: Latex, interior (gloss as indicated in Finish Schedule).

2. High-Performance Architectural Latex System:

   a. Primer: CMU block filler.
   b. Intermediate Coat: Latex, interior, high performance architectural; matching topcoat.
   c. Topcoat: Latex, interior, high performance architectural (gloss as indicated in Finish Schedule).

C. Gypsum Board Substrates:

1. Latex System:

   a. Primer: Sealer, latex, interior.
   b. Intermediate Coat: Latex, interior, matching topcoat.
   c. Topcoat: Latex, interior (gloss as indicated in Finish Schedule).

2. High-Performance Architectural Latex System:

   a. Primer: Sealer, latex, interior.
   b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (gloss as indicated in Finish Schedule).

D. Steel Substrates:

1. High-Performance Architectural Latex System:

a. Primer: Acrylic.
b. Intermediate Coat: Latex, interior, high performance architectural; matching topcoat.
c. Topcoat: Latex, interior, high performance architectural (gloss as indicated in Finish Schedule).

E. Steel (Factory-Primed) Substrates:

1. High-Performance Architectural Latex System:

a. Primer: Acrylic (applied over factory primer).
b. Intermediate Coat: Latex, interior, high performance architectural; matching topcoat.
c. Topcoat: Latex, interior, high performance architectural (gloss as indicated in Finish Schedule).

F. Galvanized Metal Substrates:

1. High-Performance Architectural Latex System:

a. Primer: Acrylic.
b. Intermediate Coat: Latex, interior, high performance architectural; matching topcoat.
c. Topcoat: Latex, interior, high performance architectural (gloss as indicated in Finish Schedule).

G. Aluminum Substrates: Not anodized or otherwise coated.

1. High-Performance Architectural Latex System:

a. Primer: Acrylic.
b. Intermediate Coat: Latex, interior, high performance architectural; matching topcoat.
c. Topcoat: Latex, interior, high performance architectural (gloss as indicated in Finish Schedule).

H. Aluminum (Anodized) Substrates:

1. High-Performance Architectural Latex System:

a. Primer: Acrylic.
b. Intermediate Coat: Latex, interior, high performance architectural; matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (gloss as indicated in Finish Schedule).

I. Aluminum (Powder-Coated) Substrates:

1. High-Performance Architectural Latex System:

a. Primer: Acrylic.
b. Intermediate Coat: Latex, interior, high performance architectural; matching topcoat.
c. Topcoat: Latex, interior, high performance architectural (gloss as indicated in Finish Schedule).

J. Wood and Hardboard Substrates:

1. High-Performance Architectural Latex System:

a. Primer: Acrylic.
b. Intermediate Coat: Latex, interior, high performance architectural; matching topcoat.
c. Topcoat: Latex, interior, high performance architectural (gloss as indicated in Finish Schedule).

K. Rubber Substrates:

1. Latex System:

a. Primer: Acrylic bonding primer or universal acrylic primer.
b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior (gloss as indicated in Finish Schedule).

2. High-Performance Architectural Latex System:

a. Primer: Acrylic bonding primer or universal acrylic primer.
b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
c. Topcoat: Latex, interior, high performance architectural (gloss as indicated in Finish Schedule).

END OF SECTION 09 91 23

SECTION 09 96 00 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of high-performance coating systems on the following substrates:

1. Exterior Substrates:

   a. Steel.
   b. Galvanized metal.
   c. Aluminum (not anodized or otherwise coated).

2. Interior Substrates:

   a. Concrete, vertical surfaces.
   b. Concrete masonry units (CMUs).
   c. Steel.
   d. Galvanized metal.
   e. Aluminum (not anodized or otherwise coated).

B. Related Requirements:

1. Section 05 12 00 "Structural Steel Framing" for shop priming of structural steel with primers specified in this Section.
2. Section 05 52 13 "Pipe and Tube Railings" for shop priming pipe and tube railings with coatings specified in this Section.
3. Section 09 91 23 "Interior Painting" for general field painting.

1.2 DEFINITIONS

A. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

B. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

C. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
2. Indicate VOC content.

B. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Coatings: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each coating system indicated 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 coating system.

   a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
   b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

   a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 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 (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Behr Process Corporation.
2. Benjamin Moore & Co.
3. Corotech Coatings; Benjamin Moore & Co.
4. Devoe Paint Company; Akzo Nobel.
5. Dulux (formerly ICI Paints); a brand of AkzoNobel.
6. PPG Architectural Finishes, Inc.
7. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.
8. Sherwin-Williams Company (The).
9. Tnemec Company, Inc.

B. Products: Subject to compliance with requirements, provide product listed in the Exterior High-Performance Coating Schedule or Interior High-Performance Coating Schedule for the coating category indicated.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be 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, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
3. Products shall be of same manufacturer for each coat in a coating system.

C. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 50 g/L.
3. Primers, Sealers, and Undercoaters: 100 g/L.
4. Rust-Preventive Coatings: 100 g/L.
5. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
6. Pretreatment Wash Primers: 420 g/L.
7. Floor Coatings: 50 g/L.
8. Shellacs, Clear: 730 g/L.
9. Shellacs, Pigmented: 550 g/L.

D. Colors: As selected by Architect from manufacturer's full range .

2.3 SOURCE QUALITY CONTROL

A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating 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 coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (CMUs): 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

1. Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi (10 350 to 27 580 kPa) at 6 to 12 inches (150 to 300 mm).
2. Abrasive blast clean surfaces to comply with SSPC-SP 7/NACE No. 4.

E. Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or alkalinity of mortar joints exceeds that permitted in manufacturer's written instructions.

1. Clean surfaces with pressurized water. Use pressure range of 100 to 600 psi (690 to 4140 kPa) at 6 to 12 inches (150 to 300 mm).

F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 6/NACE No. 3.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. 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 coatings.

I. Aluminum Substrates: Remove loose surface oxidation.

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for coating and substrate indicated.
2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.

1. Contractor shall touch up and restore coated surfaces damaged by testing.
2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, 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 coated surfaces.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Steel Substrates:

1. Epoxy System MPI EXT 5.1F:

    a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.
    b. Intermediate Coat: Epoxy, high build, low gloss, MPI #108.
    c. Topcoat: Epoxy, gloss, MPI #77.

2. Epoxy over Self-Priming Epoxy System MPI EXT 5.1S:

    a. Prime Coat: Epoxy, high build, self-priming , MPI #120.
    b. Intermediate Coat: Epoxy, matching topcoat.
    c. Topcoat: Epoxy, gloss, MPI #77.

3. Pigmented Polyurethane over Epoxy System MPI EXT 5.1H:

    a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.
    b. Intermediate Coat: Epoxy, gloss, MPI #77.

c. First and Second Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

4. Pigmented Polyurethane over High-Build Epoxy System MPI EXT 5.1J:

a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.
b. Intermediate Coat: Epoxy, high build, low gloss, MPI #108.
c. Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

B. Galvanized-Metal Substrates:

1. Epoxy System MPI EXT 5.3C:

a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, gloss, MPI #77.

1) <Insert manufacturer's name; product name or designation>.

2. Pigmented Polyurethane over Epoxy Primer System MPI EXT 5.3L:

a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.
b. Intermediate Coat: Polyurethane, two component, pigmented, gloss matching topcoat.
c. Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

C. Aluminum (Not Anodized or Otherwise Coated) Substrates:

1. Epoxy System MPI EXT 5.4E:

a. Prime Coat: Primer, vinyl wash, MPI #80.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, gloss, MPI #77.

2. Pigmented Polyurethane over Epoxy System MPI EXT 5.4B:

a. Prime Coat: Primer, vinyl wash, MPI #80.
b. Intermediate Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.
c. First and Second Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

3.7 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Concrete Substrates, Vertical Surfaces:

1. Epoxy System MPI INT 3.1F:

a. Prime Coat: Epoxy, matching topcoat.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, gloss, MPI #77.

2. Epoxy, High-Build System MPI INT 3.1P:

a. Prime Coat: High-build epoxy, matching topcoat (reduced).
b. Intermediate Coat: High-build epoxy, matching topcoat.
c. Topcoat: High-build epoxy, low gloss, MPI #108.
d. Topcoat: High-build epoxy, gloss, MPI #98.

3. Epoxy-Modified Latex System MPI INT 3.1G:

a. Prime Coat: Epoxy-modified latex, matching topcoat.
b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
c. Topcoat: Epoxy-modified latex, semi-gloss (MPI Gloss Level 5), MPI #215.
d. Topcoat: Epoxy-modified latex, gloss (MPI Gloss Level 6), MPI #115.

B. CMU Substrates:

1. Epoxy System MPI INT 4.2F:

a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
b. Block Filler: Block filler, epoxy, MPI #116.
c. Intermediate Coat: Epoxy, matching topcoat.
d. Topcoat: Epoxy, gloss, MPI #77.

2. Epoxy, High-Build System MPI INT 4.2R:

a. Prime Coat: Epoxy block filler, MPI #116.
b. Intermediate Coat: High-build epoxy, matching topcoat.
c. Topcoat: High-build epoxy, low gloss, MPI #108.
d. Topcoat: High-build epoxy, gloss, MPI #98.

3. Epoxy-Modified Latex System MPI INT 4.2J:

a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
b. Intermediate Coat: Epoxy-modified latex, interior, matching topcoat.
c. Topcoat: Epoxy-modified latex, semi-gloss (MPI Gloss Level 5), MPI #215.
d. Topcoat: Epoxy-modified latex, gloss (MPI Gloss Level 6), MPI #115.

C. Steel Substrates:

1. Epoxy System MPI INT 5.1L:

a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, gloss, MPI #77.

2. Epoxy, High-Build System MPI INT 5.1Y:

    a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.
    b. Intermediate Coat: High-build epoxy, matching topcoat.
    c. Topcoat: High-build epoxy, low gloss, MPI #108.
    d. Topcoat: High-build epoxy, gloss, MPI #98.

3. Epoxy-Modified Latex System MPI INT 5.1K:

    a. Prime Coat: Primer, rust inhibitive, water based, MPI #107.
    b. Intermediate Coat: Epoxy-modified latex, interior, matching topcoat.
    c. Topcoat: Epoxy-modified latex, semi-gloss (MPI Gloss Level 5), MPI #215.
    d. Topcoat: Epoxy-modified latex, gloss (MPI Gloss Level 6), MPI #115.

4. Pigmented Polyurethane over Epoxy Primer System MPI INT 5.1F:

    a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.
    b. Intermediate Coat: Polyurethane, two component, pigmented, matching topcoat.
    c. Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

5. Pigmented Polyurethane over High-Build Epoxy System MPI INT 5.1G:

    a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.
    b. Intermediate Coat: Epoxy, high build, MPI #108.
    c. Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

6. Pigmented Polyurethane over Self-Priming Epoxy System MPI INT 5.1U:

    a. Prime Coat: Epoxy, high build, self-priming , MPI #120.
    b. Intermediate Coat: Polyurethane, two component, pigmented, matching topcoat.
    c. Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

D. Galvanized-Metal Substrates:

1. Epoxy over Epoxy Primer System MPI INT 5.3D:

    a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.
    b. Intermediate Coat: Epoxy, matching topcoat.
    c. Topcoat: Epoxy, gloss, MPI #77.

E. Aluminum (Not Anodized or Otherwise Coated) Substrates:

1. Epoxy System MPI INT 5.4B:

    a. Prime Coat: Primer, vinyl wash, MPI #80.
    b. Intermediate Coat: Epoxy, matching topcoat.

c. Topcoat: Epoxy, gloss, MPI #77.

2. Pigmented Polyurethane System MPI INT 5.4C:

a. Prime Coat: Primer, vinyl wash, MPI #80.
b. Intermediate Coat: Epoxy, gloss, MPI #77.
c. Topcoat: Polyurethane, two-component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

END OF SECTION 09 96 00

SECTION 10 14 23.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes room-identification signs that are directly attached to the building, to match existing.

1.2 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.3 COORDINATION

A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

1.4 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. Qualification Data: For Installer and manufacturer.

E. Sample Warranty: For special warranty.

F. Maintenance Data: For signs to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Variable Component Materials: 12 replaceable text inserts and interchangeable characters (letters, numbers, and graphic elements) of each type.
2. Tools: One set of specialty tools for assembling signs and replacing variable sign components.

B. Installer Qualifications: Manufacturer of products or an entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 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.

1.7 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

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

2.2 ROOM-IDENTIFICATION SIGNS

A. Room-Identification Sign : Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ACE Sign Systems, Inc.
    b. Advance Corporation.
    c. Allen Industries Architectural Signage.
    d. APCO Graphics, Inc.
    e. ASE, Inc.
    f. ASI Sign Systems, Inc.
    g. Best Sign Systems, Inc.
    h. Clarke Systems.
    i. Cosco.
    j. Diskey Architectural Signage Inc.
    k. InPro Corporation (IPC).
    l. Mohawk Sign Systems.
    m. Nelson-Harkins Industries.
    n. Poblocki Sign Company, LLC.
    o. Seton Identification Products.
    p. Signature Signs, Inc.
    q. Signs & Decal Corp.
    r. Stamprite Supersine; a division of Stamp Rite Inc.
    s. Vista System.
    t. Vomar Products, Inc.

2. Laminated-Sheet Sign: Sandblasted polymer face sheet with raised graphics laminated over subsurface graphics to acrylic backing sheet to produce composite sheet.

    a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
    b. Subsurface Graphics: Reverse halftone or dot-screen image .
    c. Color(s): As selected by Architect from manufacturer's full range.

3. Sign-Panel Perimeter: Finish edges smooth.

    a. Edge Condition at Vertical Edges at Horizontal Edges: Square cut.
    b. Corner Condition in Elevation: Square.

4. Mounting: Manufacturer's standard method for substrates indicated with adhesive.
5. Text and Typeface: Accessible raised characters and Braille . Finish raised characters to contrast with background color, and finish Braille to match background color.

2.3 SIGN MATERIALS

A. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Acrylic Sheet: ASTM D 4802, 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[and suitable for exterior applications].

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.

2.4 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 stainless-steel 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. Adhesive: As recommended by sign manufacturer.

1. Adhesives shall have a VOC content of 70 g/L or less.

C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) 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.

2.5 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.

D. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:

1. For snap-in changeable inserts beneath removable face sheet, furnish one suction or other device to assist in removing face sheet. Furnish initial changeable insert. Subsequent changeable inserts are by Owner.
2. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. Subsequent changeable inserts are by Owner.

2.6 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.

2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

B. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 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. 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.
2. 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.
3. 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 (6.35 mm) 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.
4. 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.

3.2 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 10 14 23.16

SECTION 10 26 00 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Corner guards.

B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for stainless-steel corner guards.
2. Section 08 71 00 "Door Hardware" for stainless-steel mop, kick, armor, and push plates.

1.2 ACTION SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: Include locations and extent of impact-resistant wall protection and details of installation.

C. Samples: For each unit and for each color and texture required.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 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. Furnish full-size units of maximum length, including vinyl plastic cover and aluminum retainer, equal to 2 percent of each type, color, and texture of each type of unit installed, but no fewer than [**two**] <**Insert number**> units.

1.5 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide components with flame-spread and smoke-developed indices of not more than 25 and 450, respectively, when tested per ASTM E 84 by a testing agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: The design for each impact-resistant wall protection unit is based on the product named. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:

1. Balco, Inc.
2. Boston Retail Products.
3. Construction Specialties, Inc.
4. IPC Door and Wall Protection Systems, Inc.
5. Koroseal Wall Protection Systems, Inc.
6. K. J. Miller Corp.
7. Pawling Corporation.
8. Tri-Guards, Inc.
9. Wilkinson Company, Inc.

2.2 MATERIALS

A. Stainless-Steel Plate: Type 304, minimum 0.0625 inch (1.6 mm) thick.

B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorroding metal screws, bolts, and other fasteners compatible with aluminum components, hardware, anchors, and other items being fastened. Use vandal-resistant fasteners where exposed to view.

C. Adhesive: Type recommended by manufacturer for use with material being adhered to substrate indicated.

1. VOC Content: Comply with the following limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. Gypsum Board and Panel Adhesives: Not more than 50 g/L.
b. Multipurpose Construction Adhesives: Not more than 70 g/L.
c. Contact Adhesive: Not more than 80 g/L.

2.3 CORNER GUARDS

A. Stainless-Steel Corner Guards: Paper-covered, satin-finish, 0.050 inch (1.3 mm) minimum, stainless-steel sheet corner guards; with 90-deg ree turn, unless otherwise indicated; and formed edges.

1. Wing Size: 3-1/2 by 3-1/2 inches (89 by 89 mm).
2. Mounting: Countersunk screws with mounting holes 8 inchesxxxx (203 mm) o.c.
3. Corner Radius: 3/4 inch (19 mm).

2.4 FINISHES

A. Metal Finishes: Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary covering before shipping.

1. Stainless Steel: No. 4 finish (bright, directional polish).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Preparation: Complete finishing operations, including painting, before installing impact-resistant wall protection system components. Before installation, clean substrate to remove dust, debris, and loose particles.

B. Install impact-resistant wall protection system components level, plumb, and true to line without distortions.

1. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

C. Immediately on completion of installation, clean metal components according to manufacturer's written instructions.

1. Remove excess adhesive using methods and materials recommended by manufacturer.

END OF SECTION 10 26 00

SECTION 10 43 13 - DEFIBRILLATOR CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes defibrillator cabinets, accessories and their installation.

B. Related Sections:

1. Section 01 74 19 "Construction Waste Management and Disposal."

1.2 REFERENCES

A. American National Standards Institute/National Fire Protection Association (ANSI/NFPA):

1. ANSI/NFPA 10 Portable Fire Extinguishers.

B. American Heart Association (AHA):

1. 2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care.

1.3 ACTION SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Section 01 33 00 "Submittal Procedures."

B. Product Data: Submit product data, including manufacturer's SPEC-DATA®product sheet, for specified products.

1. Material safety data sheets.

C. Shop Drawings: Submit drawings showing exterior and interior dimensions, defibrillator mounting, corner sections, hinge arrangement and hardware.

1.4 INFORMATIONAL SUBMITTALS

A. Quality Assurance:

1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
2. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

3. Manufacturer's Instructions: Manufacturer's installation instructions.

B. Manufacturer's Field Reports: Manufacturer's field reports specified.

1.5 CLOSEOUT SUBMITTALS

A. Warranty: Submit warranty documents specified.

B. Operation and Maintenance Data: Submit operation and maintenance data for installed products in accordance with Section 01 77 00 "Closeout Procedures."

1. Include: Manufacturer's instructions covering maintenance requirements and parts catalog, giving complete list of repair and replacement parts with cuts and identifying numbers.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project.
2. Manufacturer Qualifications: Manufacturer capable of providing field service representation during construction and approving application method.

B. Regulatory Requirements.

1. International Building Code (IBC).

C. Preinstallation Meetings: Conduct preinstallation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.7 DELIVERY, STORAGE & HANDLING

A. General: Comply with Section 01 60 00 "Product Requirements."

B. Ordering: Comply with manufacturer's ordering instructions and lead time requirements toavoid construction delays.

C. Delivery: Deliver materials in manufacturer's original packaging with identification labels intact.

D. Storage and Protection: Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

E. Waste Management and Disposal:

1. Separate waste materials for reuse and recycling in accordance with Section 01 74 19 "Construction Waste Management and Disposal."
2. Remove from site and dispose of packaging materials at appropriate recycling facilities.
3. Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, and packaging material in appropriate onsite bins for recycling.

1.8 PROJECT AMBIENT CONDITIONS

A. Installation Location: Assemble and erect components only when temperatures are above 40 deg F (4 deg C).

1.9 SEQUENCING

A. Sequence with Other Work: Comply with defibrillator cabinet manufacturer¢s written recommendations for sequencing construction operations.

1.10 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. 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.

C. Warranty: Commencing on date of acceptance by Owner.

1.11 MAINTENANCE

A. Include complete maintenance on defibrillator cabinets for 12 months after date of acceptance by Owner.

B. Regularly and systematically monthly examine, clean, adjust cabinets.

C. Use only standard parts from product line of equipment manufacturer.

D. Perform work during regular trade working hours satisfactory to Owner.

E. Ensure that maintenance personnel register with designated building personnel at time of inspections and maintenance.

1.12 EXTRA MATERIALS

A. Provide maintenance materials in accordance with Section 01 77 00 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Ensure manufacturer has minimum 5 years' experience in manufacturing components similar to or exceeding requirements of project.

2.2 PROPRIETARY PRODUCTS/SYSTEMS

A. Basis of Design Manufacturer: JL Industries, Inc.

1. Contact: 4450 W 78th St. Cir., Bloomington, MN 55435; Telephone: (800) 554-6077, (952) 835-6850; Fax: (952) 835-2218; E-mail: jl@jlindustries.com; website: www.jlindustries.com.

B. Philips Defibrillator Cabinet: 14• (36 cm) wide x 22• (56 cm) high x 6• (15 cm) deep; semi-recessed.

2.3 AUTOMATIC EXTERNAL DEFIBRILLATOR (AED) CABINETS

A. Style: Interior, semi-recessed.

B. Cabinet Material:

1. Stainless steel with #4 finish.

C. Door Style: Full acrylic with vandal-resistant handle, lock and concealed hinges.

D. Trim Style: 3 inches (76 mm) return trim.

1. Frame and Door: 1.75 inches (44.44 mm).

E. Tub: Rolled edge stainless steel #4 finish.

F. Acceptable Materials: JL Industries, Inc., Lifestart 1400 Series.

2.4 ACCESSORIES

A. Vandal Resistant Handle: Cam style locking device.

1. Acceptable Material: JL Industries, Inc., SAF-T-LOK.

B. Cabinet Seal:

1. Acceptable Material: JL Industries, Inc., SAF-T-CLASP.

C. Alarm: Ensure 85 dB horn sounds for 2 minutes minimum when door is opened and stops when door closes.

1. Keyed Alarm: On/Off.
2. Horn Power: 9 Volt DC battery with low power indicator.
3. Acceptable Material: JL Industries, Inc., model Commander Alarm.

D. Defibrillator:

1. Acceptable Material: Medtronic ERS, Model Lifepak CR Plus.

2.5 IDENTIFICATION

A. Identify defibrillator cabinets in accordance with ANSI/NFPA 10 using silk-screen print on inside of acrylic.

1. Acceptable Material: JL Industries, Inc., Defibrillator Cabinet Identification.

2.6 SOURCE QUALITY CONTROL

A. Ensure defibrillator cabinet components and materials are from single manufacturer.

2.7 PRODUCT SUBSTITUTIONS

A. Substitutions: In accordance with Section 01 60 00 "Product Requirements. No substitutions permitted.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Provide experienced and qualified technicians to carry out erection, assembly and installation of defibrillator cabinets.

3.2 MANUFACTURER¢S INSTRUCTIONS

A. Compliance: Comply with manufacturer¢s written data, including product technical bulletins, product catalog installation instructions, product carton installation instructions and JL Industries, Inc., SPEC-DATA sheets.

3.3 EXAMINATION

A. Site Verification of Conditions:

1. Verify that substrates previously installed under other sections or contracts are acceptable for product installation in accordance with manufacturer¢s instructions prior to installation of defibrillator cabinets.
2. Inform Architect of unacceptable conditions immediately upon discovery.
3. Proceed with installation only after unacceptable conditions have been remedied.

3.4 PREPARATION

A. Ensure surfaces are clean and free of dirt and other foreign matter harmful to performance of defibrillator cabinet materials.

3.5 INSTALLATION

A. Install defibrillator cabinets as indicated.

B. Arrangement of Equipment: Arrange equipment so that removal for repairs or replacement does not require undue dismantling or removing of other equipment components.

C. Coordinate defibrillator cabinet work with work of other trades for proper time and sequence to avoid construction delays.

3.6 ADJUSTMENT

A. Adjust defibrillator cabinet doors to achieve smooth operation.

3.7 FINAL CLEANING

A. Do cleanup in accordance with Section 01 77 00 "Final Cleaning."

B. Upon completion, remove surplus and excess materials, rubbish, tools and equipment.

3.8 DEMONSTRATION

A. Instruct Owner's designated maintenance personnel in care, adjustment and operation of defibrillator cabinets.

B. If required, provide competent instructor for not less than 1 4-hour training session after completion and acceptance of work.

C. Forward statement to Owner countersigned by maintenance personnel confirming that these instructions have been provided.

3.9 PROTECTION

A. Protect installed products from damage during construction.

END OF SECTION 10 43 13

SECTION 10 44 00 - FIRE-PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section fire protection specialties includes fire extinguishers and fire extinguisher cabinets.

1.2 COORDINATION

A. Coordinate size of fire-extinguisher cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

1.3 ACTION SUBMITTALS

A. Product Data: Submit product data including construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.

1. Fire Extinguishers: Include rating and classification.
2. Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, panel style.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fire extinguishers and fire-protection cabinets through one source from a single manufacturer.

B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."

C. Listing: Fire extinguishers shall be UL listed with UL Listing Mark for type, rating, and classification of extinguisher.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of portable fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10.

b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHERS

A. General: Provide fire extinguishers for each fire extinguisher cabinet and at other locations indicated.

1. Mounting Brackets: Manufacturer's standard steel, designed to secure extinguisher indicated and with plated or baked-enamel finish.

a. Provide brackets for extinguishers located and not located in cabinets.

B. Multipurpose Dry-Chemical Type: UL-rated 4-A:60-B:C, 10-lb. (4.5-kg) nominal capacity, in enameled-steel container.

C. Located on Drawings by Designation: FE.

D. HVAC, refrigeration, and fire suppression equipment and systems, shall contain no CFCs or halons.

2.2 FIRE-EXTINGUISHER CABINETS

A. General: Provide fire extinguisher cabinets of suitable size for housing fire extinguishers of types and capacities specified.

B. Cabinet Construction: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames.

1. Fire-Rated Cabinets: Listed and labeled to meet requirements in ASTM E 814 for fire-resistance rating of wall where it is installed.

a. Construct fire-rated cabinets with double walls fabricated from 0.0478 inch (1.2 mm) thick, cold-rolled steel sheet lined with minimum 5/8 inch (16 mm) thick, fire-barrier material.

2. Cabinet Material: Enameled-steel sheet.
3. Cabinet Mounting: Recessed unless otherwise indicated.
4. Cabinet Trim Style: Trimless with hidden flange of same metal and finish as box that overlaps surrounding wall finish and that is concealed from view by an overlapping door.
5. Cabinet Trim Material: Manufacturer's standard steel sheet.
6. Door Material: Manufacturer's standard [steel] [#4 stainless steel] sheet.
7. Door Glazing: Manufacturer's standard, as follows:

a. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, Class 1 (clear).

8. Door Style: Manufacturer's standard design vertical duo panel with frame with 1/4 inch (6 mm) thick glass.
9. Door Construction: Fabricate doors according to manufacturer's standards, of materials indicated, and coordinated with cabinet types and trim styles selected.
10. Door Hardware: Provide manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide exposed door pull and friction latch. Provide concealed or continuous-type hinge permitting door to open 180 degrees.

C. 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. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.

a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."

1) Location: Applied to cabinet door.
2) Application Process: Pressure-sensitive vinyl letters.
3) Lettering Color: Red.
4) Orientation: Vertical.

D. Products and Manufacturers: One of the following:

1. Larsens Manufacturing Company; Occult Series Fire Extinguisher Cabinets.
2. Potter Roemer; Dana Series Fire Extinguisher Cabinets.
3. JL Industries, Inc.; Embassy Series Fire Extinguisher Cabinets.

E. Located on Drawings by designation: FEC.

2.3 FINISHES

A. General: Apply finishes in factory after products are assembled. Protect cabinets with plastic or paper covering, prior to shipment.

B. Painted Finishes: Provide painted finish to comply with requirements indicated below for extent, preparation and type:

1. Color: Provide color or color matches indicated, or, if not otherwise indicated, as selected by Architect from manufacturer's standard colors.
2. Preparation: Clean surfaces of dirt, grease, and loose rust or mill scale.

3. Field-Paintable Factory Finish: Immediately after cleaning and pretreatment, apply to surfaces indicated below, manufacturer's standard factory-applied paint system which is suitable, after deglossing, as an undercoat for field-applied paint system specified in Section 09 91 23 "Interior Painting."

    a. Exterior of cabinet except for those surfaces indicated to receive another finish.
    b. Interior of cabinet.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.2 INSTALLATION

A. General: Follow manufacturer's printed instructions for installation.

B. Install fire-protection specialties in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

1. Fasten cabinets to structure, square and plumb.

3.3 ADJUSTING AND CLEANING

A. Adjust cabinet doors to operate freely without binding. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged units.

B. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

END OF SECTION 10 44 00

SECTION 10 56 13 - METAL STORAGE SHELVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Four-post metal storage shelving.

1.2 COORDINATION

A. Coordinate sizes and locations of blocking and backing required for installation of metal storage shelving attached to wall and ceiling assemblies.

B. Coordinate locations and installation of metal storage shelving that may interfere with ceiling systems including lighting, HVAC, speakers, sprinklers, access panels, electrical switches or outlets, and floor drains.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, construction details, material descriptions, dimensions of individual components and profiles, and finishes for metal storage shelving.

B. Shop Drawings: For metal storage shelving.

1. Include plans, elevations, sections, and attachment details.
2. Include installation details of connectors, lateral bracing, and special bracing.

C. Samples for Verification: For the following components, of size indicated below:

1. Vertical Supports: 12 inches (305 mm) tall.
2. Shelves: Full size, but not more than 24 inches wide by 12 inches deep (610 mm wide by 305 mm deep).
3. Connectors: Full size.
4. Shelf-Label Holders: Full size.

D. Delegated-Design Submittal: For seismic restraint of metal storage shelving.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For metal storage shelving, accessories, and components, from manufacturer.

C. Product Certificates: For each type of metal storage shelving.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal storage shelving to include in maintenance manuals.

1.7 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. Shelves: Full-size units equal to 5 percent of amount installed for each type indicated, but no fewer than 5 shelves.
2. Shelf-to-Post Connectors: Full-size units equal to 5 percent of amount installed for each type indicated, but no fewer than 10 connectors.
3. Shelf-Label Holders: Full-size units equal to 5 percent of amount installed for each type indicated, but no fewer than 10 holders.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install metal storage shelving until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for building occupants during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design metal storage shelving, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Seismic Performance: Metal storage shelving shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Seismic Component Importance Factor: 1.0.

2.2 FOUR-POST METAL STORAGE SHELVING

A. Open Four-Post Metal Storage Shelving : Complying with MH 28.1 and field assembled from factory-formed components. Shelves span between supporting corner posts that allow shelf-height adjustment over full height of shelving unit. Provide fixed top and bottom shelves, adjustable intermediate shelves, and accessories indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Borroughs Corporation.
b. Lyon Workspace Products, LLC.
c. Penco Products, Inc.
d. Republic Storage Systems, LLC.
e. Spacesaver Corporation.

2. Load-Carrying Capacity per Shelf: 700 lb (318 kg) .
3. Posts: Fabricated from hot-rolled steel; in manufacturer's standard shape; with perforations at 1-1/2 inches (38 mm) o.c. to receive shelf-to-post connectors.

a. Unit Configuration: Configure shelving units as individual, freestanding assemblies.

1) Add-On Shelf Posts: Fabricated from hot-rolled steel, manufacturer's standard shape; perforated to match main posts.

b. Post Base: Adjustable steel floor plate, drilled for floor anchors.

4. Bracing: Manufacturer's standard, single or double diagonal cross bracing.

a. Location: At unit back and ends as required for stability, load-carrying capacity of shelves, and number of shelves indicated.

5. Back Panel: One piece fabricated from cold-rolled steel sheet.

    a. Steel Sheet Thickness, Nominal: As required for load-carrying capacity per shelf.

6. End Panels: Fabricated from cold-rolled steel sheet.

    a. Steel Sheet Thickness, Nominal: As required for load-carrying capacity per shelf.

7. Solid-Type Shelves:

    a. Steel Sheet: Nominal thickness as required for load-carrying capacity per shelf.
    b. Metallic-Coated Steel Sheet: Nominal thickness as required for load-carrying capacity per shelf.
    c. Fabricate fronts and backs of shelves with vertical edges that are flanged and returned, with edges reinforced with steel bars, angles or channels.

8. Shelf Quantity: Four shelves per shelving unit in addition to top and bottom shelf.
9. Shelf-to-Post Connectors: Manufacturer's standard connectors.
10. Base: Open, with exposed post legs.
11. Overall Unit Width: As indicated on Drawings , inclusive of two end posts.
12. Overall Unit Depth: As indicated on Drawings .
13. Overall Unit Height: As indicated on Drawings.
14. Accessories:

    a. Finished End Panels: Fabricated as solid full-height panels from manufacturer's standard thickness cold-rolled steel sheet and with same finish as posts, with trim for a finished appearance along edges abutting posts and top shelf.
    b. Shelf Dividers: Fabricated from same material and with same finish as shelves; full-height type.
    c. Shelf-Label Holders: Clear plastic, designed to clip onto front edge of shelf.

15. Steel Finish: Baked enamel or powder coat.

    a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.3 ANCHORS

A. Floor Anchors: Galvanized-steel, post-installed expansion anchors . Provide number per unit recommended by manufacturer unless additional anchors are indicated in calculations.

B. Wall Anchors: Manufacturer's standard, galvanized-steel anchors designed to secure metal storage shelving to adjacent wall. Provide one per shelving unit for each shelving unit adjacent to a wall unless additional anchors are indicated in calculations.

2.4 FABRICATION

A. Fabricate metal storage shelving components to provide field-assembled units that are square and rigid, with posts plumb and true and shelves flat and free of dents or distortion. Fabricate connections to form a rigid structure, free of buckling and warping.

1. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.
2. Build in straps, plates, brackets, and other reinforcements as needed to support shelf loading.
3. Cut, reinforce, drill, and tap metal fabrications to receive hardware, fasteners, and similar items.

B. Form metal in maximum lengths to minimize joints. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

C. Form edges and corners free of sharp edges or rough areas. Fold back and crimp exposed edges of unsupported sheet metal to form a hem on the concealed side; ease edges of metal plate to radius of approximately 1/32 inch (0.8 mm). Shear and punch metals cleanly and accurately. Remove burrs.

D. Weld corners and seams continuously to develop strength, minimize distortion, and maintain the corrosion resistance of base metals. At exposed locations, finish welds and surfaces smooth and blended so surface is smooth after finishing and contour of welded surface matches that of adjacent surface. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces before finishing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine floors for suitable conditions where metal storage shelving will be installed.

C. Examine walls to which metal storage shelving will be attached for properly located blocking, grounds, or other solid backing for attachment of support fasteners.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Vacuum and clean finished floor over which metal storage shelving is to be installed.

3.3 INSTALLATION

A. Install metal storage shelving level, plumb, square, rigid, true, and with shelves flat and free of dents or distortion. Make connections to form a rigid structure, free of buckling and warping.

1. Install exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
2. Install braces, straps, plates, brackets, and other reinforcements as needed to support shelf loading and as required for stability.
3. Anchor shelving units to floor with floor anchors through floor plate. Shim floor plate to achieve level and plumb installation.
4. Install seismic restraints.
5. Connect side-to-side and back-to-back shelving units together.
6. Install shelves in each shelving unit at spacing indicated on Drawings.

    a. Four-Post Metal Storage Shelving: Install four clips, one at each post, for support of each shelf; with clips fully engaged in post perforations.

B. Accessories:

1. Install finished end panels and trim at exposed ends of shelving units.
2. Shelf Dividers: Install at locations indicated on Drawings.
3. Shelf-Label Holders: Install one on each shelf.

    a. Install at locations indicated on Drawings within each shelving unit.

3.4 ERECTION TOLERANCES

A. Erect four-post metal storage shelving to a maximum tolerance from vertical of 1/2 inch (13 mm) in up to 10 feet (3 m) of height, not exceeding 1 inch (25 mm) for heights taller than 10 feet (3 m).

3.5 ADJUSTING

A. Adjust metal storage shelving so that connectors and other components engage accurately and securely.

B. Adjust and lubricate operable components to operate smoothly and easily, without binding or warping. Check and readjust operating hardware.

C. Touch up marred finishes or replace metal storage shelving that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by metal storage shelving manufacturer.

D. Replace metal storage shelving components that have been damaged beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 56 13

SECTION 11 31 00 - APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Refrigerator/freezers.

B. Related Requirements:

1. Division 22 Sections for natural gas, water distribution, drainage, and vent piping and plumbing fixtures.
2. Division 26 Sections for electrical services and connections to appliances.

1.2 ACTION SUBMITTALS

A. Product Data: Submit product data and roughing in diagrams for each type of appliance required indicating compliance with requirements. Include complete operating characteristics, dimensions of individual appliances, finishes for each appliance, and maintenance instructions for each appliance.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of appliance, from manufacturer.

B. Field quality-control reports.

C. Warranties: Sample of special warranties specified in this Section.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each appliance to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain appliances from single source and each type of appliance from single manufacturer.

B. AHAM Standards: http://www.aham.org

1. Refrigerators and Freezers: Total volume and shelf area ratings certified according to ANSI/AHAM HRF-1.

C. Energy Ratings: Provide appliances that carry labels indicating energy-cost analysis (estimated annual operating costs) and efficiency information as required by the FTC Appliance Labeling Rule.

D. UL and NEMA Compliance: Provide electrical components required as part of ppliances that are listed and labeled by UL and that comply with applicable NEMA standards.

E. Energy Ratings: Provide appliances that carry labels indicating energy-cost analysis (estimated annual operating costs) and efficiency information as required by the FTC Appliance Labeling Rule.

1. Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.

F. Accessibility: Where appliances are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1 and local regulations.

1.6 DELIVERY

A. Deliver appliances only after utility rough-in is complete and construction in spaces to receive appliances is substantially complete and ready for installation.

1.7 WARRANTY

A. Special Warranty, Not A Standard Manufacturer's Warranty: Provide Special Extended Service Agreement in which the manufacturer agrees to repair or replace appliance that fails in materials and workmanship within specified warranty period for the intended light commercial use.

1. Warranty Period: Three years from date of Substantial Completion, 2 year warranty on compressor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: The design for each appliance is based on Tru Food Service Equipment, Inc. T-35-HC (refrigerator) and T-35F-HC (freezer). Subject to compliance with requirements, provide the named product or a comparable product by one of the following:

1. BSH Home Appliances Corporation (Thermador).

2. Electrolux Home Products (Frigidaire).
3. General Electric Company (GE).

2.2 APPLIANCES

A. Provide product listed in Equipment Schedules and on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of appliances.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Comply with manufacturer's written instructions.

B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

D. Utilities: Refer to the Drawings and Divisions 22 and 26 for plumbing and electrical requirements.

3.3 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. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After installation, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

C. An appliance will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 ADJUSTING AND CLEANING

A. Test each item of appliances to verify proper operation. Make necessary adjustments.

B. Verify that accessories required have been furnished and installed.

C. Remove packing material from appliances and leave units in clean condition, ready for operation.

END OF SECTION 11 31 00

SECTION 11 66 23 - GYMNASIUM EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exercise equipment.

B. Related Requirements:

1. Section 09 65 66 "Resilient Athletic Flooring".
2. Section 09 68 16 "Turf Flooring".

1.2 DEFINITIONS

A. NCAA: The National Collegiate Athletic Association.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include assembly, disassembly, and storage instructions for removable equipment.
2. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.

B. Shop Drawings: For gymnasium equipment.

1. Include plans, elevations, sections, and attachment details.
2. Include details of field assembly for removable equipment, connections, installation, mountings, floor inserts, and operational clearances.
3. Include transport and storage accessories for removable equipment.
4. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For each type of gymnasium equipment.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Layout plans, reflected ceiling plans, and other details, drawn to scale, and coordinated with ceiling-suspended gymnasium equipment, floor inserts, game lines, and markers applied to finished flooring, and coordinated with each other, using input from installers of the items involved:

1. Structural members to which overhead-supported gymnasium equipment will be attached.
2. Suspended ceiling components, if any.
3. Items supported from building structure above the courts, including the following:

    a. Luminaires.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Smoke detectors.
    f. Acoustical treatments or panels.
    g. Access panels.

B. Setting Drawings: For embedded items and cutouts required in other work.

C. Qualification Data: For Installer.

D. Product Certificates: For each type of gymnasium equipment.

E. Field quality-control reports.

F. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For gymnasium equipment to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products or an entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify position and elevation of floor inserts and layout for gymnasium equipment.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of gymnasium equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Revise articles below to suit Project. These include paragraphs that are examples of gymnasium equipment and are not intended to be all inclusive. Indicate individual equipment or assembled system dimensions and elevations on Drawings. Use these example paragraphs as guides for developing paragraphs for other types of gymnasium equipment.

2.2 EXERCISE EQUIPMENT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Arizona Courtlines, Inc.
2. Draper Inc.
3. Jaypro Sports, LLC.
4. Performance Sports Systems.
5. Porter Athletic Equipment Company.

B. Source Limitations: Obtain from single source from single manufacturer.

1. Fixed Pad Glute Ham Bench.
2. Nordic Hamstring.
3. Dumbbells (lbs.):

    a. 5, 10, 15, 20 , 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130, 135, 140, 145, 150.

4. 3- tier Dumbell Racks.
5. Adjustable Benches for Dumbbell Area.
6. Benches for Platforms.
7. Dual Pulldown/rows.
8. Pull Up Dual.
9. Pull Up Rotating.
10. Battle Ropes.
11. Half Racks.
12. Rack Storage.

13. 10 lb. Olympic Plates.
14. 2.5 lb. Olumpic Plates.
15. 5 lb.Olympic Plates.
16. 45 lb. Bumper Plates.
17. 25 lb. Bumper Plates.
18. 10 lb. Bumper Plates.
19. Iron Grip DB's.
20. RFE Rack Attachments.
21. Eleiko Bars 20 kg.
22. Eleiko Bars 10 kg.
23. Power Bars.
24. Power Blocks 90 lbs. with Stands.
25. DC Blocks sets of 12 - 18.
26. Trap Bars.
27. Safety Squat Bars.
28. TRX.
29. Collars.
30. Cable for Pillars.
31. Kettlebells (various weights - kg):

    a. 6, 12, 16, 20, 24, 28.

32. Slideboards.
33. Sleds.
34. Plyo Boxes - set stackable Foam Black.
35. Pit Shark.
36. Leg Press.
37. Leg Extension.
38. Leg Curl.
39. Calf Raise.
40. Chest Press.
41. Machine Row.
42. Woodway Motorized Treadmill.
43. Woodway Curve Treadmill.
44. Ellipticals.
45. Stairmaster 8 Series Gauntlet.
46. Fan Bikes.
47. Spin Bikes.
48. Rowers.
49. Pro 5 Silver Power Plates.
50. Axel Bars,
51. Chalk Bins.

2.3 MATERIALS

A. Castings and Hangers: Malleable iron, according to ASTM A47/A47M; grade as required for structural loading.

B. Softwood Plywood: DOC PS 1, exterior.

C. Particleboard: ANSI A208.1.

D. Equipment-Mounting Board: Wood, transparent or neutral-color-painted finish; size and quantity as required to mount gymnasium equipment according to manufacturer's written instructions.

E. Anchors, Fasteners, Fittings, and Hardware: Gymnasium equipment manufacturer's standard corrosion-resistant or noncorrodible units; concealed; tamperproof, vandal- and theft-resistant design.

F. Grout: Nonshrink, nonmetallic, premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout, according to ASTM C1107/C1107M, with minimum strength recommended in writing by gymnasium-equipment manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for court layout, alignment of mounting substrates, installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance of the Work.

1. Verify critical dimensions.
2. Examine supporting structure, subgrades, subfloors, and footings below finished floor.
3. Examine wall assemblies, where reinforced to receive anchors and fasteners, to verify that locations of concealed reinforcements are clearly marked. Locate reinforcements and mark locations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions.

B. Install gymnasium equipment after other finishing operations, including painting, have been completed unless otherwise indicated.

C. Permanently Placed Gymnasium Equipment and Components: Install rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated; in proper relationship to adjacent construction; and aligned with court layout.

1. Floor-Insert Elevation: Coordinate installed heights of floor inserts with installation of finish flooring and floor-plate type.

2. Operating Gymnasium Equipment: Verify clearances for movable components of gymnasium equipment throughout entire range of operation and for access to operating components.

D. Anchoring to In-Place Construction: Use anchors and fasteners where necessary to secure built-in and permanently placed gymnasium equipment to structural support and to properly transfer load to in-place construction.

E. Connections: Connect electric operators to building electrical system.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform visual inspections and operational tests as recommended by the equipment manufacturer.

C. Gymnasium equipment will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust movable components of gymnasium equipment to operate safely, smoothly, easily, and quietly; free from binding, warp, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range; and lubricate as recommended in writing by manufacturer.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain gymnasium equipment.

END OF SECTION 11 66 23

SECTION 12 36 16 - METAL COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stainless-steel countertops.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For metal fabrications.

1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
2. For countertops, show locations and sizes of cutouts and holes for items installed in metal countertops.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver products only after casework and supports on which they will be installed has been completed in installation areas.

B. Keep finished surfaces of products covered with polyethylene film or other protective covering during handling and installation.

1.4 FIELD CONDITIONS

A. Field Measurements: Where products 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

2.1 STAINLESS-STEEL FABRICATIONS

A. Countertops: Fabricate from 0.062-inch- (1.59-mm-) thick, stainless-steel sheet. Provide smooth, clean exposed tops and edges in uniform plane, free of defects. Provide front and end overhang of 1 inch (25 mm) over the base cabinets.

1. Joints: Fabricate countertops without field-made joints.
2. Weld shop-made joints.
3. Sound deaden the undersurface with heavy-build mastic coating.
4. Extend the top down to provide a 1-inch- (25-mm-) thick edge with a 1/2-inch (12.7-mm) return flange.
5. Form the backsplash coved to and integral with top surface, with a 1/2-inch- (12.7-mm-) thick top edge and 1/2-inch (12.7-mm) return flange.
6. Provide raised (marine) edge around perimeter of tops containing sinks; pitch tops containing sinks two ways to provide drainage without channeling or grooving.

2.2 MATERIALS

A. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

B. Sealant for Countertops: Manufacturer's standard sealant that complies with applicable requirements in Section 07 92 00 "Joint Sealants" and the following:

1. Mildew-Resistant Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, silicone .
2. Joint Sealant: Single component, nonsag, neutral curing, silicone; Class 25.
3. Color: Clear.
4. Sealant shall have a VOC content of 250 g/L or less.

2.3 STAINLESS-STEEL FINISH

A. Grind and polish surfaces to produce uniform, directional satin finish matching No. 4 finish, with no evidence of welds and free of cross scratches. Run grain with long dimension of each piece. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install metal countertops level, plumb, and true; shim as required, using concealed shims.

B. Field Jointing: Where possible, make field jointing in the same manner as shop jointing; use 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.

C. Secure countertops to cabinets with Z- or L-type fasteners or equivalent; use two or more fasteners at each front, end, and back.

D. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.

E. Seal junctures of countertops, splashes, and walls with sealant for countertops.

3.3 CLEANING AND PROTECTION

A. Repair or remove and replace defective work as directed on completion of installation.

B. Clean finished surfaces. Remove and replace damaged products or touch up and refinish damaged areas to match original factory finish, as approved by Architect.

C. Protection: Provide 6-mil (0.15-mm) plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at a minimum of 48 inches (1220 mm) o.c. Remove protection at Substantial Completion.

END OF SECTION 12 36 16

SECTION 210000 - FIRE SUPPRESSION PIPING SYSTEMS

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.

B. Divisions 22 and 23.

1.2 REVISION TO DIVISION NUMBERING

A. These documents have been revised to reflect new numbering standards. All Mechanical documents were previously contained within Division 15. These documents have now been divided into Fire Protection, Plumbing and HVAC and renumbered as Divisions 21, 22 and 23, respectively.

1.3 COORDINATION OF DIVISIONS 21, 22 AND 23.

A. Divisions 21, 22 and 23 are used to communicate the requirements for the total Mechanical scope of work. It is intended for these three Divisions to serve as a single document, communicating the Mechanical scope of work.

1.4 SCOPE OF WORK/DESIGN CRITERIA

A. The meaning and intention of these specifications, in conjunction with the drawing(s), is to cover a completely installed, fully operating fire sprinkler protection system for the remodeled area. To accomplish this purpose, the Contractor shall provide all design, materials, equipment and labor necessary and required, and bear all expenses incidental to the satisfactory completion of the work.

B. It shall be the Contractor's responsibility to design and install the system so that no interferences exist between the fire protection piping, and equipment and systems installed by other disciplines.

C. Comply with applicable local codes, state and local Fire Marshal's standards, International Building Code, International Fire Code, and NFPA 13 for installation and design of systems.

D. The design shall be governed first and foremost by code compliance and secondly by the specifications/contract documents. If a discrepancy exists between code and contract documents, the stricter shall be complied with. If such discrepancy exists, notification is expected and an addendum will be issued.

E. Contractor is responsible for fees and permit costs related to installing system except as noted.

F. Contractor shall perform hydrostatic testing of all system piping in accordance with NFPA Pamphlet 13. Provide complete Contractor Material and Test Certificates for each system/portion of system tested.

G. Provide dry sprinkler system in those areas indicated on the drawings and as required in areas subject to freezing.

H. Provide and install water flow detection switches for each sprinkler zone. Provide supervisory valve tamper switches for all sprinkler control valves. The installation of site exterior piping and valving is not indicated on Division 23 drawings. The Section 211000 contractor shall provide required tamper switches for exterior valves.

I. Piping shown on the project drawings is considered diagrammatic. The drawings include the locations of all major system equipment and bulk mains. Locations of the interior piping may vary from the drawing as approved by the Engineer and as coordinated with the Contractor. The Contractor shall field fit piping as required in areas such as Mechanical Rooms. Contractor shall provide all required incidental devices, valves, switches, piping, etc., to achieve a complete system whether indicated on the drawings or not.

J. Interface with Building Fire Alarm system in accordance with code.

1.5 APPROPRIATE USE OF CONSTRUCTION DOCUMENTS

A. These specifications and accompanying drawings are intended to communicate the design concept for this project and outline the scope of work. They should not be viewed as a comprehensive document that details every specific task, item, or piece of equipment required to complete the project. It is understood that industry knowledge and experience is required to establish an accurate and complete scope of work from these documents, and it is assumed that the Division 21 Contractor possesses that knowledge and experience. Work not specifically noted in these specifications or the accompanying drawings, but which is required to complete the project, shall be included by the Division 21 Contractor as part of his/her scope of work.

B. These specifications and the accompanying drawings are intended to supplement each other. Information included in either one shall be incorporated into the project as if included in both. In the event of any conflicts, the most stringent requirements shall be considered the governing scope of work until and unless clarification can be obtained by the Contractor.

C. In the event of dimensional discrepancies between Division 21 documents and other disciplines, Architectural and Structural documents take precedence over Division 21. Refer to this information for sufficient understanding to the extent that it impacts the Division 21 scope of work.

D. Drawings are intended to indicate the general arrangement of piping, ductwork, equipment and other components of Division 21 systems. They shall be followed as closely as possible, but shall be considered diagrammatic in nature. They are not intended to show every component, fitting, offset, etc. Components, fittings, offsets, etc. as required to meet the intent of the documents and to achieve coordination with other trades shall be included in the Division 21 scope of work. Note that more detailed information about routing may be provided for certain

areas of the project where special constraints exist. It is the intent of this detailed information to better communicate the constraints, but these drawings and details shall still be considered diagrammatic in nature as outlined above.

1.6 REFERENCES

A. General

1. Division 00 and Division 01 of these specifications shall govern Division 21 work, including Bidding Requirements, Conditions of the Contract, and Supplementary Conditions. It is the Division 21 Contractor's responsibility to be aware of all information and requirements included in these locations, and to include those requirements as part of the Division 23 scope of work.

2. It shall be understood by the Division 21 Contractor that the Division 21 scope of work is intended to involve a coordinated effort with all other Divisions of work. Refer to other sections of the documents for additional related requirements and to ensure a coordinated effort.

3. References to industry standards, testing procedures, etc. are noted in individual sections of these specifications. The requirements and standards from the referenced documents shall be considered part of the requirements of these specifications.

4. It shall be understood by the Contractor that the Division 21 information is intended to serve as a single document, and each section of these specifications directly or indirectly relates to all other sections. As such, each section does not attempt to identify every other Division 21 section that is related. Significant references to information outside of Division 21 are, however, occasionally provided for informational purposes. This information is provided to assist in coordination, but the lack of a reference to another portion of the Contract Documents does not relieve the Contractor of the responsibility for coordination with other sections of Division 21 and all other trades.

5. Fire Protection Piping

6. ANSI/ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800

7. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings, Class 150 and 300

8. ANSI/ASME B16.4 - Cast Iron Threaded Fittings, Class 125, and 250

9. ASME/ANSI B16.5 - Pipe Flanges and Flanged Fittings

10. ASME/ANSI B16.9 - Factory-made Wrought Steel Buttwelding Fittings

11. ASME B16.11 - Forged Steel Fittings, Socket-welding and Threaded

12. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings

13. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

14. ASME B16.25 - Buttwelding Ends

15. ASME B36.10 - Welded and Seamless Wrought Steel Pipe

16. ASTM A47 - Malleable Iron Castings

17. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless

18. ASTM A135 - Electric-Resistance-Welded Steel Pipe

19. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

20. ASTM A795 - Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use

21. ASTM B32 - Solder Metal

22. ASTM B75 - Seamless Copper Tube

23. ASTM B88 - Seamless Copper Water Tube

24. ASTM B251 - General Requirements for Wrought Seamless Copper and Copper-Alloy Tube

25. AWS D109 - Specifications for Qualification of Welding Procedures and Welders for Piping and Tubing

26. AWWA C110 - Ductile Iron and Gray Iron Fittings

27. AWWA C151 - Ductile Iron Pipe, Centrifugally Cast

28. UL – Fire Protection Equipment Directory

B. Miscellaneous

1. UL 262 - Gate Valves for Fire-Protection Service

2. UL 312 - Check Valves for Fire-Protection Service

3. UL 405 - Fire Department Connections

4. NFPA 13 - Installation of Sprinkler Systems

5. NFPA 24 - Installation of Private Fire Service Mains and their Appurtenances

1.7 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.8 SUBMITTALS

A. General

1. Product data for specified materials.

2. Shop Drawings: Diagram power, signal, and control wiring.

3. Fire-hydrant flow test report.

4. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable.

5. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in [NFPA 13] [NFPA 13 and NFPA 14] [NFPA 14]. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

6. Welding certificates.

1.9 OPERATION AND MAINTENANCE MATERIALS

A. General: Product data for specified items.

1.10 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

C. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."

2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."

3. NFPA 14, "Installation of Standpipe, Private Hydrant, and Hose Systems."

4. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

5. NFPA 230, "Fire Protection of Storage."

D. All mechanical equipment shall have an AIC rating of 100,000 or otherwise specified on electrical one-line diagrams fault current for each piece of equipment.

1.11 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

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. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

PART 2 PRODUCTS

2.1 FIRE SUPPRESSION PIPING, ABOVE GRADE

A. NPS 2 and Smaller

1. Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795; Schedule 40 black, standard weight steel pipe.

2. Fittings

a. Cast-Iron Threaded Flanges: ASME B16.1.
b. Malleable-Iron Threaded Fittings: ASME B16.3.
c. Gray-Iron Threaded Fittings: ASME B16.4.
d. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
e. Steel Threaded Couplings: ASTM A 865.

2.2 LISTED GENERAL FIRE-PROTECTION VALVES

A. Valves shall be UL listed or FMG approved, with 175-psig (1200 kPa) minimum pressure rating. Valves shall have 300-psig (2070-kPa) pressure rating if valves are components of high-pressure piping system.

B. Manufacturers

1. Central
2. Grinnell
3. Kennedy
4. Stockham
5. Victaulic

C. Ball Valves: Comply with UL 1091, except with ball instead of disc.

1. NPS 1-1/2 (DN 40) and Smaller: Bronze body with threaded ends.
2. NPS 2 and NPS 2-1/2 (DN 50 and DN 65): Bronze body with threaded ends or ductile-iron body with grooved ends.
3. NPS 3 (DN 80): Ductile-iron body with grooved ends.

D. Butterfly Valves: UL 1091.

1. NPS 2 (DN 50) and Smaller: Bronze body with threaded ends.
2. NPS 2-1/2 (DN 65) and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.

E. Check Valves NPS 2 (DN 50) and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.

F. Gate Valves: UL 262, OS&Y type.

1. NPS 2 (DN 50) and Smaller: Bronze body with threaded ends.
2. NPS 2-1/2 (DN 65) and Larger: Cast-iron body with flanged ends.

2.3 MANUAL CONTROL STATIONS

A. Manual Control Stations: UL listed or FMG approved, hydraulic operation, with union, NPS 1/2 (DN 15) pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.4 SPRINKLERS

A. Manufacturers

1. Central Sprinkler Corp.

2. Grinnell Fire Protection

3. Reliable Automatic Sprinkler Co., Inc.

4. Star Sprinkler Inc.

5. Victaulic Co. of America

6. Viking Corp.

B. Sprinklers shall be UL listed or FMG approved, with 175-psig (1200-kPa) minimum pressure rating. Sprinklers shall have 300-psig (2070-kPa) pressure rating if sprinklers are components of high-pressure piping system.

C. Automatic Sprinklers: With heat-responsive element complying with the following:

1. UL 199, for nonresidential applications.

2. UL 1626, for residential applications.

3. UL 1767, for early-suppression, fast-response applications.

D. Sprinkler Types and Categories: Nominal 1/2-inch (12.7-mm) orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.

E. Sprinkler Finishes: Chrome plated, bronze, and painted.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, 2 piece, with 1-inch (25-mm) vertical adjustment.

2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

G. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

2.5 SPRINKLER SPECIALTY FITTINGS

A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig (1200-kPa) minimum working-pressure rating, and made of materials compatible with piping. Sprinkler specialty fittings shall have 300-psig (2070-kPa) working-pressure rating if fittings are components of high-pressure piping system.

B. Outlet Specialty Fittings:

1. Mechanical-T and -Cross Fittings: UL 213, ductile-iron housing with gaskets, bolts and nuts, and threaded, locking-lug, or grooved outlets.

2. Snap-On and Strapless Outlet Fittings: UL 213, ductile-iron housing or casting with gasket and threaded outlet.

C. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.

D. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.

E. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.

F. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.

G. Dry-Pipe-System Fittings: UL listed for dry-pipe service.

2.6 UNLISTED GENERAL-DUTY VALVES: REFER TO SECTION 220523.

PART 3 EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13, NFPA 14, and NFPA 291. Use results for system design calculations required in Part 1 "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PIPING APPLICATIONS, GENERAL

A. Shop weld pipe joints where welded piping is indicated.

B. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

3.4 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Listed Fire-Protection Valves: UL listed and FMG approved for applications where required by NFPA 13 and NFPA 14.

    a. Shutoff Duty: Use ball, butterfly, or gate valves.

2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13 and NFPA 14.

    a. Shutoff Duty: Use ball, butterfly, or gate valves.
    b. Throttling Duty: Use ball or globe valves.

3.5 JOINT CONSTRUCTION

A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 (DN 200) with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gauge and comply with ASME B1.20.1.

C. Twist-Locked Joints: Insert plain-end piping into locking-lug fitting and rotate retainer lug one-quarter turn.

D. Pressure-Sealed Joints: Use UL-listed tool and procedure. Include use of specific equipment, pressure-sealing tool, and accessories.

E. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.

1. Ductile-Iron Pipe: Radius-cut-groove ends of piping. Use grooved-end fittings and grooved-end-pipe couplings.

2. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.

3. Copper Tube: Roll-groove tubing. Use grooved-end fittings and grooved-end-tube couplings.

4. Dry-Pipe Systems: Use fittings and gaskets listed for dry-pipe service.

F. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials.

1. NPS 2 (DN 50) and Smaller: Use dielectric unions, couplings, or nipples.

2. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.

3. NPS 5 (DN 125) and Larger: Use dielectric flange insulation kits.

3.6 PIPING INSTALLATION

A. Refer to Division 22 Section "Basic Plumbing Materials and Methods" for basic piping installation.

B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

C. Install underground copper service-entrance piping according to NFPA 24.

D. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.

F. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install drain valves on standpipes.

K. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.

L. Install alarm devices in piping systems.

M. Hangers and Supports: Comply with NFPA 13 for hanger materials.

1. Install standpipe system piping according to NFPA 14.

2. Install sprinkler system piping according to NFPA 13.

N. Earthquake Protection: Install piping according to NFPA 13 to protect from earthquake damage.

O. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gauges with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they will not be subject to freezing.

P. Drain dry-type standpipe piping.

Q. Drain dry-pipe sprinkler piping.

R. Pressurize and check dry-pipe sprinkler system piping and air-pressure maintenance devices.

S. Fill wet-standpipe system piping with water.

T. Fill wet-pipe sprinkler system piping with water.

U. Install flexible connectors on fire-pump and pressure-maintenance-pump supply and discharge connections and in fire-suppression piping where indicated.

3.7 SPRINKLER APPLICATIONS

A. Drawings indicate sprinkler types to be used. Where specific types are not indicated, use the following sprinkler types:

1. Rooms without Ceilings: Upright sprinklers.

2. Rooms with Suspended Ceilings: Recessed sprinklers

3. Wall Mounting: Sidewall sprinklers.

4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers.

5. Deluge-Sprinkler Systems: Upright and pendent, open sprinklers.

6. Sprinkler Finishes:

a. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.
b. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
c. Flush Sprinklers: Bright chrome, with painted white escutcheon.
d. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.

3.8 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels and tiles.

B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

3.9 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Connect water-supply piping to fire-suppression piping. Include backflow preventer between potable-water piping and fire-suppression piping. Refer to Division 22 Section "Domestic Water Piping Systems" for backflow preventers.

D. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.

E. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.

F. Connect excess-pressure pumps to the following piping and wiring:

1. Sprinkler system, hydraulically.

2. Pressure gauges and controls, hydraulically.

3. Electrical power system.

4. Alarm device accessories for pump.

5. Fire alarm.

G. Electrical Connections: Power wiring is specified in Division 26.

H. Connect alarm devices to fire alarm.

I. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

J. Connect wiring according to Division 26 Section "Building Voltage Electrical Power Conductors and Cables."

K. 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 and UL 486B.

3.10 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13/14 and in Section 220553.

3.11 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

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. Energize circuits to electrical equipment and devices.

4. Start and run excess-pressure pumps.

5. Start and run air compressors.

6. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.

7. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.

8. Coordinate with fire alarm tests. Operate as required.

9. Coordinate with fire-pump tests. Operate as required.

10. Verify that equipment hose threads are same as local fire department equipment.

B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.12 CLEANING AND PROTECTION

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

C. Protect sprinklers from damage until Substantial Completion.

3.13 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

END OF SECTION 3.13

SECTION 22 00 00 - GENERAL PLUMBING REQIREMENTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. It is intended for the Division 22 scope of work to include complete and functional plumbing systems - including all required materials, labor, equipment, and services necessary to achieve the desired final product. It is further intended for the Division 22 scope of work to include coordination with Divisions 21 and 23 and all work required by Division 22 for complete Fire Protection and HVAC systems.

1.2 REVISION TO DIVISION NUMBERING

A. These documents have been revised to reflect new numbering standards. All Mechanical documents were previously contained within Division 15. These documents have now been divided into Fire Protection, Plumbing and HVAC and renumbered as Divisions 21, 22 and 23, respectively.

1.3 COORDINATION OF DIVISIONS 21, 22 AND 23.

A. Divisions 21, 22 and 23 are used to communicate the requirements for the total Mechanical scope of work. It is intended for these three Divisions to serve as a single document, communicating the Mechanical scope of work.

1.4 REFERENCES

A. Division 00 and Division 01 of these specifications shall govern Division 22 work, including Bidding Requirements, Conditions of the Contract, and Supplementary Conditions. It is the Division 22 Contractor's responsibility to be aware of all information and requirements included in these locations, and to include those requirements as part of the Division 22 scope of work.

B. It shall be understood by the Division 22 Contractor that the Division 22 scope of work is intended to involve a coordinated effort with all other Divisions of work. Refer to other sections of the documents for additional related requirements and to ensure a coordinated effort.

C. References to industry standards, testing procedures, etc. are noted in individual sections of these specifications. The requirements and standards from the referenced documents shall be considered part of the requirements of these specifications.

D. This section applies to all Division 22 work. The Division 22 Contractor shall ensure that all Division 22 work described throughout other specification sections and on the drawings is in accordance with this section.

E. It shall be understood by the Contractor that the Division 22 information is intended to serve as a single document, and each section of these specifications directly or indirectly relates to all other sections. As such, each section does not attempt to identify every other Division 22 section that is related. Significant references to information outside of Division 22 are, however, occasionally provided for informational purposes. This information is provided to assist in

coordination, but the lack of a reference to another portion of the Contract Documents does not relieve the Contractor of the responsibility for coordination with other sections of Division 22 and all other trades.

F. Definitions

G. The following definitions shall apply to the use of these words when used in Division 22. These definitions are not intended to define use of these words outside of Division 22.

H. Acceptance: The Owner's assumption of ownership of the plumbing system.

I. 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.

J. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

K. Contractor (The Contractor, This Contractor, Division 22 Contractor, etc.): The contractor responsible for the Division 22 scope of work.

L. Date of Acceptance: The official date when Acceptance occurs. This will coincide with the granting of Substantial Completion unless noted otherwise by the Owner's Representative. It shall not be assumed that the Date of Acceptance has deviated from Substantial Completion unless written documentation is provided by the Owner's Representative indicating differently.

M. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

N. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

O. 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.

P. Mechanical: Shall refer in a consolidated manner to and be interchangeable with "Divisions 21, 22 and 23".

Q. Plumbing: Shall be considered interchangeable with "Division 22".

R. Owner's Representative: The Architect or his designated representative, as outlined in the General Conditions.

S. Provide: Furnish and install.

1.5 ABBREVIATIONS

A. The following are industry abbreviations used in these specifications: ABS: Acrylonitrile-butadiene-styrene plastic; ASJ: All-service jacket; BR: Butyl rubber; Buna-N: Nitrile rubber; CPVC: Chlorinated polyvinyl chloride plastic; CR: Chlorosulfonated polyethylene synthetic rubber; CSM: Chlorosulfonyl-polyethylene rubber; CWP: Cold working pressure; DDC: Direct digital control; DOP: Dioctyl phthalate or bis-(2-ethylhexyl) phthalate; EMCS: Energy Management and Control System; EPDM: Ethylene-propylene-diene terpolymer rubber; FOG: Fats, oils, and greases; FRP: Fiberglass-reinforced plastic; FSK: Foil, scrim, kraft paper; FSP: Foil, scrim, polyethylene; HDPE: High-density polyethylene plastic; HEPA: High-efficiency particulate air; I/O: Input/output; LLDPE: Linear, low-density polyethylene plastic; MS/TP: Master slave/token passing; MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.; NBR: Acrylonitrile-butadiene rubber; NC: Noise criteria; NR: Natural rubber; NUSIG: National Uniform Seismic Installation Guidelines; PE: Polyethylene plastic; PEX: Crosslinked polyethylene plastic; PC: Personal computer; PID: Proportional plus integral plus derivative; PMMA: Polymethyl methacrylate (acrylic) plastic; PP: Polypropylene plastic; PTFE: Polytetrafluoroethylene plastic; PUR: Polyurethane plastic; PVC: Polyvinyl chloride plastic; PVDC: Polyvinylidene chloride; RC: Room criteria; RTD: Resistance temperature detector; SSL: Self-sealing lap; SWP: Steam working pressure; TFE: Tetrafluoroethylene plastic; TPE: Thermoplastic elastomer; ULPA: Ultra low penetration air.

1.6 APPLICABLE CODES

A. Division 22 work shall be performed in accordance with applicable codes and standards as adopted by the authorities having jurisdiction including amendments. Following is a listing of major codes and standards, the requirements of which shall be considered part of the scope of this project. This list should not be considered comprehensive, and codes or standards not included in this list should not be considered to be excluded from the scope of the project.

1. Americans with Disabilities Act (ADA)

2. Applicable State and Local Codes and Ordinances

3. National Electrical Code

4. International Building Code

5. International Fire Code

6. International Mechanical Code

7. Uniform Plumbing Code

8. Washington State Non-Residential Energy Code

9. Washington State Indoor Air Quality Code

10. Washington State Boiler and Unfired Pressure Vessel Code.

1.7 PERMITS AND FEES

A. All permits and inspections required to complete the Division 22 scope of work shall be included in the Division 22 bid price. All certifications provided as part of the permit and inspection process shall be provided to the Owner as part of the Division 22 scope of work as specified in these documents.

B. All fees required by utility providers shall be included in the Division 22 bid price, including water, gas, sanitary sewer, and storm sewer connections. This shall include all charges to the project by these agencies, including but not limited to general fees, equipment charges (meters, vaults, etc.), tap fees, and utility main installation charges.

1.8 ALTERNATES (REFER TO DIVISION 01)

A. The bid price for the scope of work shall be separated into base bid and alternate values when indicated. Both base bid and alternate bid prices shall reflect a complete and working plumbing system, with specific features and/or portions of the systems designated as base bid or alternate as described.

1.9 SCOPE AND APPROPRIATE USE OF BID DOCUMENTS

A. These specifications and accompanying drawings are intended to communicate the design concept for this project and outline the scope of work. They should not be viewed as a comprehensive document that details every specific task, item, or piece of equipment required to complete the project. It is understood that industry knowledge and experience is required to establish an accurate and complete scope of work from these documents, and it is assumed that the Division 22 Contractor possesses that knowledge and experience. Work not specifically noted in these specifications or the accompanying drawings, but which is required to complete the project, shall be included by the Division 22 Contractor as part of his scope of work.

B. These specifications and the accompanying drawings are intended to supplement each other. Information included in either one shall be incorporated into the project as if included in both. In the event of any conflicts, the most stringent requirements shall be considered the governing scope of work until and unless clarification can be obtained by the Contractor.

C. In the event of dimensional discrepancies between Division 22 documents and other disciplines, Architectural and Structural documents take precedence over Division 22. Refer to this information for sufficient understanding to the extent that it impacts the Division 22 scope of work.

D. Drawings are intended to indicate the general arrangement of piping, ductwork, equipment and other components of Division 22 systems. They shall be followed as closely as possible, but shall be considered diagrammatic in nature. They are not intended to show every component, fitting, offset, etc. Components, fittings, offsets, etc. as required to meet the intent of the documents and to achieve coordination with other trades shall be included in the Division 22 scope of work. Note that more detailed information about routing may be provided for certain areas of the project where special constraints exist. It is the intent of this detailed information to better communicate the constraints, but these drawings and details shall still be considered diagrammatic in nature as outlined above.

1.10 ROUTING AND LOCATIONS

A. It is the Contractor's responsibility to coordinate equipment locations and system routing with available space and with all other trades.

B. It is the Contractor's responsibility to coordinate and verify the exact locations and routing of equipment and systems prior to fabrication and installation. If discrepancies become apparent as part of the verification process, the Contractor shall ask for written clarification/direction. Alteration, removal and/or replacement of work already installed as a result of failure to verify and/or coordinate locations and routing prior to fabrication and/or installation shall be at the Contractor's expense.

C. Locations of equipment shown on the drawings are approximate unless specifically dimensioned.

D. All ductwork, piping, tubing, conduit, etc. shall be concealed within building construction unless noted otherwise. Mechanical rooms are considered to be within building construction for the purposes of this requirement.

E. Existing utilities, piping, and ductwork have been indicated as closely as possible. The Contractor can assume that points of connection to existing utilities have been shown within 10 feet (3 meters) of the actual location. When actual points of connection are more than 10 feet (3 meters) from the location shown on the drawings, the Contractor shall notify the Owner's Representative prior to commencing this portion of the work.

F. The Contractor is responsible for any remedial work required from failure to locate and preserve underground utilities. This shall include all work necessary to repair any damaged utilities to their original condition.

1.11 SCHEDULING

A. It is understood that while drawings are to be followed as closely as circumstances permit, the Contractor shall be responsible for installation of systems according to the true intent and meaning of Contract Documents. Anything not clear or in conflict will be explained by making application to Owner's Representative. The Contractor shall familiarize himself with his scope of work as well as the required coordination with other trades and the scheduling of other trades sufficiently to address coordination issues in a timely manner such that they do not result in remedial work for other trades.

B. Should conditions arise where certain changes would be advisable, secure approval from Owner's Representative for those changes before proceeding with work. Proceeding without written approval is at the Contractor's risk and at the Contractor's expense.

C. The contractor shall coordinate with the work of various trades when installing interrelated work. Before installation of plumbing items, proper provisions shall be made to avoid interferences. Changes required in work specified in Division 22 caused by neglect to do so shall be made at no cost to Owner.

D. Inserts and supports required by Division 22 shall be furnished and installed unless otherwise noted. Furnish sleeves, inserts, supports, and equipment that are an integral part of other Divisions of the Work to those involved in sufficient time to be built into construction as the Work proceeds. Locate these items and see that they are properly installed. Expense resulting from improper location or installation of items above shall be borne under Division 22.

1.12 CUTTING AND PATCHING

A. The Division 22 Contractor shall be responsible for all cutting and patching required to complete the Division 22 scope of work.

B. All patching shall be performed such that it matches existing finishes.

C. The Contractor shall not cut any structural members without first getting approval from the Owner's Representative to do so.

D. All cutting and patching required to correct defective or otherwise unacceptable work shall be the responsibility of the Division 22 Contractor.

1.13 GUARANTEE (REFER TO DIVISION 01)

A. All Division 22 systems and equipment shall be guaranteed for a minimum period of one year.

B. Specific equipment and/or systems requiring warranties beyond one year are indicated in the table at the end of this section.

C. The guarantee shall begin at the Date of Acceptance, unless written documentation is provided noting otherwise. When more than one Date of Acceptance is indicated for various portions or specific equipment, the guarantee shall begin at the Date of Acceptance independently for each portion of the system or piece of equipment.

D. Permission to use Division 22 systems or equipment for temporary heating or other contractor use prior to the Date of Acceptance, as outlined elsewhere in these specifications, shall not constitute the beginning of the guarantee period. The contractor shall make any necessary arrangements to extend equipment and/or system warranties sufficient to maintain the designated guarantee period from the Date of Acceptance.

1. Exception: When temporary heating and or other system use is requested by the Owner for the Owner's benefit prior to the Date of Acceptance, the guarantee period for the portions of the system or specific equipment requested for use may begin at the time it is put into service. This can only be assumed to have occurred if written documentation is provided indicating such.

1.14 QUALITY ASSURANCE

A. Material and Equipment Qualifications

1. Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and

workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

2. Alternative Qualifications: Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

B. Service Support: The equipment items shall be supported by service organizations. When requested to gain approval, submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

C. Manufacturer's Nameplate: Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

D. UL Listings: All equipment shall be provided with a UL or approved equivalent label when labeling is available for that type of equipment.

E. Fuel-fired equipment shall be labeled by the appropriate nationally recognized label for the fuel type (i.e. AGA).

F. All control panels shall be UL listed (or equivalent approved label).

G. Pressure vessels shall be provided in accordance with applicable pressure vessel ordinances.

H. All mechancial equipment shall have an AIC rating of 100,000 or otherwise specified on electrical one-line diagrams fault current for each piece of equipment.

1.15 SUBSTITUTIONS (REFER TO DIVISION 01)

A. When multiple manufacturers are listed in these specifications, equipment can be used from those manufacturers providing they can meet the requirements of the specifications and drawings. This shall include meeting capacity requirements, efficiencies, space and weight limitations, electrical provisions, etc. The detailed information in the specifications, scheduled equipment information, additional drawing information and any specific references to a particular manufacturer and/or model of equipment shall be considered the basis of design. Other listed manufacturers, even when listed in these specifications, will only be allowed if they meet or exceed that basis of design.

B. Substitutions involving manufacturers not listed in these specifications will not be allowed without written approval. When written approval is requested, information will be reviewed in preliminary fashion for general conformance only. Any approved manufacturers will still be

required to meet the requirements of these specifications and the drawings, and final approval during submittal review will only be granted if the equipment meets or exceeds the requirements of the documents.

C. It is the Contractor's responsibility when utilizing approved substituted equipment to ensure the equipment will fit within the constraints of the project as detailed using the basis of design equipment (space, weight, power, etc.). Any required alterations by Division 22 or any other Division of work to accommodate differences between the substituted equipment and the basis of design equipment shall be the responsibility of the Division 22 Contractor, including the cost of design for the required changes.

D. If the changes required by substituted equipment cannot be accommodated, the Contractor shall be responsible for replacing the substituted equipment with the basis of design equipment.

E. Proposed substituted equipment will not be considered equal if it requires an increase of more than 5% in power usage at design conditions.

1.16 PLUMBING COST BREAKDOWN (REFER TO DIVISION 01)

A. Provide a breakdown of construction costs within 30 days of Notice to Proceed, with separate costs for each of the items listed in the table at the end of this section.

1.17 PAYMENT REQUESTS

A. Submittals and operation and maintenance data must be received and approved before payment requests will be considered for materials and equipment.

1.18 SUBMITTALS (REFER TO DIVISION 01)

A. Submittal information shall be provided and approved on all materials and equipment prior to ordering.

B. Provide indication of which options and accessories are to be included.

C. Include all scheduled information for equipment listed in schedules on the drawings.

D. Review will be for general conformance only, and shall not relieve the Contractor for any deviations from the requirements of the documents unless clear written reference is made by the Contractor in the submittal to proposed deviations.

E. All Division 22 information shall be provided in one complete submittal, indexed by specification section.

1. Exceptions: At the discretion of the Owner's Representative, partial submittals may be provided. If allowed, provide a table indicating submittal status with each submittal, and provide an initial submittal with all required tabs and space for all current and future submittals.

F. Provide operation and maintenance data for individual equipment after initial submittals have been reviewed.

G. Efficiency Standards

1. Units requiring more than a 5% increase in power input beyond the scheduled equipment to meet design capacities will not be considered equal.

2. Units requiring more than a 5% increase in fan brake horsepower over the scheduled equipment to meet the design flow and external static pressure requirements will not be considered equal and will not be accepted.

1.19 DELIVERY, STORAGE, AND HANDLING

A. Follow manufacturer's directions in delivery, storage, protection, and installation of equipment and materials.

B. Promptly notify Owner's Representative in writing of conflicts between requirements of Contract Documents and Manufacturer's directions and obtain written instructions from Owner's Representative before proceeding with work. The Contractor shall bear expenses arising from correcting deficiencies of work that do not comply with manufacturer's directions or such written instructions from Owner's Representative.

C. Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.20 OPERATION AND MAINTENANCE MANUALS

A. Provide a consolidated Operation and Maintenance Manual for Divisions 21, 22 and 23. Refer to Section 230000 for requirements.

1.21 OPERATION AND MAINTENANCE TRAINING

A. Provide consolidated training for Divisions 21, 22 and 23. Refer to Section 230000 for requirements.

1.22 EXTRA MATERIALS

A. A list of extra materials to be provided under this contract has been included at the end of this section. Refer to individual specification sections for specific requirements of extra materials to be furnished under this contract.

B. Turn extra materials over to Owner.

1. Provide summarized list of extra materials that have been furnished. List shall include verification by Owner's Representative that parts have been furnished. Incorporate into O&M Manual. Extra materials list shall be similar to that provided at the end of this section.

1.23 CLEANING

A. Leave all equipment and systems in a clean and new condition at the completion of the project. Clean all piping and ductwork exposed in finished spaces. Remove all stickers from equipment in finished spaces (plumbing fixtures, etc.). Repair all scratched and damaged equipment to new condition, to include touch-up painting.

1.24 RECORD DRAWINGS

A. Maintain a set of Contract Documents dedicated for record drawings. These documents shall incorporate all clarifications and changes provided by the Owner's Representative, as well as field changes made by the Contractor. All markings shall be neat and legible. Turn over documents to the Owner's Representative at the completion of the project.

1.25 PUNCH LISTS

A. Notify the Owner's Representative in writing when the project is ready for punch lists.

B. When all punch list items have been addressed, notify the Owner's Representative in writing that the project is ready for a backcheck of completed punch list items. Include a copy of the original punch list with each completed item initialed and any required notation indicating if something was not completed and why.

C. If, at the time of the backcheck, items are found that continue to be in nonconformance with the project documents, these items will be forwarded to the Contractor. Completion of these items shall be required to achieve substantial completion. All site visits required beyond the initial punch list and initial back check visits, including visits required to verify completion of these remaining outstanding items, shall be charged to the Contractor at normal billing rates.

1.26 VISITING THE PROJECT SITE

A. The premises shall be examined and conditions shall be understood which may affect performance of work of this Division before submitting proposals for this work.

B. No subsequent allowance for time or money will be considered for any consequence related to failure to examine existing site conditions.

PART 2 **PRODUCTS (NOT USED)**
PART 3 **EXECUTION (NOT USED)**

PART 4 **TABLES**

4.1 PLUMBING COST BREAKDOWN TABLE

Plumbing Cost Breakdown Table		
Category	**Material Cost**	**Labor / Installation Cost**
Mobilization		
Supervision		
Site Utilities		
Plumbing Seismic Restraint		
Plumbing Identification		
Plumbing Insulation		
Domestic Water Rough-In		
Waste and Vent Rough-In		
Miscellaneous Rough-In		
Plumbing Equipment (Floor Drains, Roof Drains, Water Hammer Arrestors, Valves, Hot Water Tanks, etc.)		
Water Heaters		
Plumbing Fixtures		
Commissioning Assistance		

4.2 SUBMITTAL TABLE

Submittal Table				
	Submittal Data Included	**Submittal Previously Approved**	**O&M Data Included**	**O&M Previously Approved**
220500 – Basic Plumbing Materials and Methods				
Access Doors				
Dielectric Fittings				
Escutcheons				
Mechanical Sleeve Seals				
Welding Certificates				
220523 – Plumbing General Duty Valves				
Ball Valves				
Butterfly Valves				
Check Valves – Horizontal Swing				
Check Valves – Lift Disc, Spring Loaded				
220529 – Plumbing Hangers and Supports				
Fastener Systems				
Thermal Hanger Shield Inserts				
Metal Framing Systems				
Welding Certificates				
220553 – Plumbing Identification				
Access Panel and Door Markers				
Ceiling Tacks				
Nameplates				
Pipe Markers				
Tags				
Valve Schedules - A preliminary chart shall be submitted at submittal time, and shall be updated as part of the as-built documentation process.				
List of all equipment/items to receive nameplates indicating designation to be printed on nameplate.				
220700 – Plumbing Insulation				
Pipe Insulation – Cellular Foam				
Pipe Insulation – Glass Fiber				
Pipe Insulation – Calcium Silicate				
Pipe Insulation – Cellular Glass				
Pipe Jacketing				
Equipment Insulation – Glass Fiber				
Schedule Including Piping Systems, Insulation Type, Insulation Thickness Relative To Pipe Size				

Submittal Table				
	Submittal Data Included	**Submittal Previously Approved**	**O&M Data Included**	**O&M Previously Approved**
Schedule Including Equipment, Insulation Type, Insulation Thickness				
221100 – Domestic Water Piping Systems				
Water Piping, Buried				
Water Piping, Above Grade				
Air Vents				
Double-Check Backflow Preventers				
Intermediate Atmospheric Vent Backflow Preventers				
Reduced Pressure Backflow Preventers				
Clothes Washer Outlet Box				
Drain Valves				
Flow Control Balancing Valves				
Non-Freeze Ground Hydrants				
Hose Bibbs/Wall Hydrants				
Hose Stations				
Mixing Valves				
Post Hydrants				
Strainers				
Trap-Seal Primer Valves				
Trap-Seal Primer Systems				
Water Hammer Arresters				
Water Meters				
Water Pressure Reducing Valves				
Section 221300 – Sanitary Waste and Vent Piping Systems				
Waste and Vent Piping (Unpressurized), Buried				
Waste and Vent Piping (Unpressurized), Above Grade				
Waste and Vent Piping (Pressurized), Buried				
Waste and Vent Piping (Pressurized), Above Grade				
Flexible, Nonpressure Pipe Couplings				
Shielded Nonpressure Pipe Couplings				
Rigid, Unshielded, Nonpressure Pipe Couplings				
Pressure Pipe Couplings				
Flexible Ball Joints				
Wall Penetration Fittings				
Backwater Valves				
Cleanouts				

Submittal Table				
	Submittal Data Included	**Submittal Previously Approved**	**O&M Data Included**	**O&M Previously Approved**
Floor Drains				
Trap-Seal Primers				
Grease Interceptors				
Section 223400 – Water Heaters				
Commercial Water Heaters – Gas-Fired, Storage, High Efficiency				
Waste and Vent Piping (Unpressurized), Above Grade				
224000 - Plumbing Fixtures (Submit by P-Numbers)				
Counter-Mounted Lavatories (Vitreous China)				
Drinking Fountains				
Electric Water Coolers				
Emergency Eye-Wash				
Emergency Showers				
Floor-Mounted Flush Valve Water Closets				
Floor-Mounted Service Sinks				
Floor-Mounted Tank Type Water Closets				
Showers				
Stainless Steel Sinks				
Tubs				
Urinals				
Wall-Mounted Flush Valve Water Closets				
Wall-Mounted Lavatories (Cast Iron)				
Wall-Mounted Lavatories (Vitreous China)				
Wall-Mounted Service Sinks				
Wall-Mounted Tank Type Water Closets				

4.3 EXTRA MATERIALS LIST

Extra Materials List				
Specification Section	**Mechanical Equipment**	**Extra Materials**	**Verified By**	**Date**
221100	Domestic Water Piping Systems	Two (2) Loose Keys for Frost Proof Wall Hydrants		
224000	Plumbing Fixtures	10% (minimum of two (2)) Sets of Faucet Washers and O-Rings for Each Type/Size Installed		
224000	Plumbing Fixtures	10% (minimum of two (2)) of Each Different Filter Cartridge Type		
224000	Flush Valves	Flush Valve Service Kits		

4.4 EXTENDED WARRANTY LIST

Extended Warranty List		
Specification Section	**Plumbing Equipment**	**Warranty Description**
223400	Water Heater	Heat Exchangers: 5 year warranty
223400	Water Heater/Storage Tank	Tanks: 3 year warranty

END OF SECTION 4.4

SECTION 22 05 23 - GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOLCUMENTS

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

B. Refer to Section 22 05 00 – Common Work Results for Plumbing.

1.2 SUMMARY

A. Section Includes

1. Bronze ball valves.
2. Balancing Valves
3. Bronze lift check valves.
4. Bronze swing check valves.
5. Iron, wafer spring check valves.
6. Bronze gate valves.
7. Iron gate valves.
8. Lubricated plug valves.
9. Chain wheels.

B. Related Sections

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Section 22 05 53 – Identification for Plumbing Piping and Equipment for valve tags and schedules.
3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.3 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.

G. SWP: Steam working pressure.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 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.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 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 angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

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 hand wheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to 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. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
5. 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. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Nib-seal handle extension.
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.

2.2 NIBCOBRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim

1. Manufacturers: Subject to compliance with requirements as indicated on the Drawings and specified herein.
2. Provide NIBCO Inc T-685-80-66-LF or equal product by one of the following:

    a. ConBraCo Industries, Inc.; Apollo Valves
    b. Hammond Valve
    c. Milwaukee Valve Company
    d. Kennedy Valve
    e. Red-White Valve Corporation

3. Description

    a. Standard: MSS SP-110, NSF 61-G.
    b. CWP Rating: 600 psig.
    c. Body Design: Two piece.
    d. Body Material: Lead free bronze.
    e. Ends: Threaded.
    f. Seats: PTFE or TFE.
    g. Stem: Stainless steel.
    h. Ball: Stainless steel, vented.
    i. Port: Full.

B. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim

1. Manufacturers: Subject to compliance with requirements as indicated on the Drawings and specified herein.
2. Provide NIBCO Inc T-595-Y-66-LF or equal product by one of the following:

    a. ConBraCo Industries, Inc.; Apollo Valves
    b. Hammond Valve
    c. Milwaukee Valve Company
    d. Kennedy Valve
    e. Red-White Valve Corporation

3. Description

    a. Standard: MSS SP-110, NSF 61-G.

b. CWP Rating: 600 psig.
c. Body Design: Three piece.
d. Body Material: Lead free bronze.
e. Ends: Threaded.
f. Seats: PTFE or TFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

2.3 BALANCING VALVES

A. Memory-Stop Balancing Valves

1. Manufacturers: Subject to compliance with requirements as indicated on the Drawings and specified herein.
2. Provide NIBCO S/T-685-80-LFInc S/T-685-80-LF-M or equal product by one of the following:

    a. ConBraCo Industries, Inc.
    b. Hammond Valve
    c. Milwaukee Valve Company
    d. Red-White Valve Corp.

3. Standard: MSS SP-110 for two-piece, copper-alloy ball valves, NSF 61-G.
4. Pressure Rating: 400-psig minimum CWP.
5. Size: NPS 2 or smaller.
6. Body: Copper alloy.
7. Port: Full port.
8. Ball: Lead free bronze.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.4 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Non Metallic Disc

1. Manufacturers: Subject to compliance with requirements as indicated on the Drawings and specified herein.
2. Provide NIBCO Inc T-480-Y-LF or equal product by one of the following:

    a. ConBraCo Industries, Inc.; Apollo Valves

b. Hammond Valve
c. Milwaukee Valve Company
d. Kennedy Valve
e. Red-White Valve Corporation

3. Description

a. Standard: MSS SP-80, Type 1, NSF 61-G.
b. CWP Rating: 200 psig.
c. Body Design: Vertical flow.
d. Body Material: ASTM B 584 Alloy C87850, lead free bronze.
e. Ends: Threaded.
f. Disc: TFE.

2.5 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Non Metallic Disc

1. Manufacturers: Subject to compliance with requirements as indicated on the Drawings and specified herein.
2. Provide NIBCO Inc T-413-Y-LF or equal product by one of the following:

a. ConBraCo Industries, Inc.; Apollo Valves
b. Hammond Valve
c. Milwaukee Valve Company
d. Kennedy Valve
e. Red-White Valve Corporation

3. Description

a. Standard: MSS SP-80, Type 3, NSF 61-G.
b. CWP Rating: 300 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 584 Alloy C87850, lead free bronze.
e. Ends: Threaded.
f. Disc: TFE.

2.6 IRON, WAFERSPRING CHECK VALVES

A. 250 CWP, Iron, Grooved-End Swing Check Valves

1. Manufacturers: Subject to compliance with requirements as indicated on the Drawings and specified herein.
2. Provide NIBCO Inc. W-920-W, Victaulic Company. Inc or equal product by one of the following:

    a. Anvil International, Inc.
    b. Shurjoint Piping Products
    c. Tyco Fire Products LP; Grinnell Mechanical Products

3. Description

    a. CWP Rating: 250 psig.
    b. Body Material: ASTM A 536, ductile iron.
    c. Seal: Buna.
    d. Disc: Spring-operated, ductile iron or stainless steel.

2.7 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves

1. Manufacturers: Subject to compliance with requirements as indicated on the Drawings and specified herein.
2. Provide NIBCO Inc T-113-LF or equal product by one of the following:

    a. ConBraCo Industries, Inc.; Apollo Valves
    b. Hammond Valve
    c. Milwaukee Valve Company
    d. Kennedy Valve
    e. Red-White Valve Corporation

3. Description

    a. Standard: MSS SP-80, Type 1, NSF 61-G.
    b. CWP Rating: 200 psig.
    c. Body Material: ASTM B 584 Alloy C87850, lead free bronze with integral seat and threaded bonnet.
    d. Ends: Threaded.
    e. Stem: Silicon Bronze.
    f. Disc: Solid wedge; lead free bronze.
    g. Packing: Asbestos free.
    h. Handwheel: Malleable iron.

2.8 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves

1. Manufacturers: Subject to compliance with requirements as indicated on the Drawings and specified herein.
2. Provide NIBCO Inc F-619-RW or equal product by one of the following:

    a. ConBraCo Industries, Inc.; Apollo Valves
    b. Crane Co.; Crane Valve Group; Crane Valves
    c. Hammond Valve
    d. Milwaukee Valve Company
    e. Kennedy Valve
    f. Red-White Valve Corporation

3. Description

    a. Standard: MSS SP-70, Type I.
    b. CWP Rating: 200 psig.
    c. Body Material: ASTM A 126, gray iron with bolted bonnet.
    d. Ends: Flanged.
    e. Trim: lead free material.
    f. Disc: Solid wedge, EPDM encapsulated.
    g. Packing and Gasket: Asbestos free.

2.9 LUBRICATED PLUG VALVES

A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends

1. Manufacturers: Subject to compliance with requirements as indicated on the Drawings and specified herein.
2. Provide or equal product by one of the following:

    a. Nordstrom Valves, Inc.
    b. ConBraCo Industries, Inc.; Apollo Valves
    c. Crane Co.; Crane Valve Group; Crane Valves
    d. Hammond Valve
    e. Milwaukee Valve Company
    f. Kennedy Valve
    g. Red-White Valve Corporation

3. Description

    a. Standard: MSS SP-78, Type II.
    b. CWP Rating: 200 psig.
    c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
    d. Pattern: Regular or short.
    e. Plug: Cast iron or bronze with sealant groove.

B. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends

1. Manufacturers: Subject to compliance with requirements as indicated on the Drawings and specified herein.
2. Provide or equal product by one of the following:

    a. Nordstrom Valves, Inc.
    b. ConBraCo Industries, Inc.; Apollo Valves
    c. Crane Co.; Crane Valve Group; Crane Valves
    d. Hammond Valve
    e. Milwaukee Valve Company
    f. Kennedy Valve
    g. Red-White Valve Corporation

3. Description

    a. Standard: MSS SP-78, Type II.
    b. CWP Rating: 200 psig.
    c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
    d. Pattern: Regular or short.
    e. Plug: Cast iron or bronze with sealant groove.

C. Class 250, Regular-Gland, Lubricated Plug Valves with Threaded Ends

1. Manufacturers: Subject to compliance with requirements as indicated on the Drawings and specified herein.
2. Provide or equal product by one of the following:

    a. Nordstrom Valves, Inc.
    b. ConBraCo Industries, Inc.; Apollo Valves
    c. Crane Co.; Crane Valve Group; Crane Valves

d. Hammond Valve
e. Milwaukee Valve Company
f. Kennedy Valve
g. Red-White Valve Corporation

3. Description

a. Standard: MSS SP-78, Type II.
b. CWP Rating: 400 psig.
c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
d. Pattern: Regular or short.
e. Plug: Cast iron or bronze with sealant groove.

D. Class 250, Regular-Gland, Lubricated Plug Valves with Flanged Ends

1. Manufacturers: Subject to compliance with requirements as indicated on the Drawings and specified herein.
2. Provide or equal product by one of the following:

a. Nordstrom Valves, Inc.
b. ConBraCo Industries, Inc.; Apollo Valves
c. Crane Co.; Crane Valve Group; Crane Valves
d. Hammond Valve
e. Milwaukee Valve Company
f. Kennedy Valve
g. Red-White Valve Corporation

3. Description

a. Standard: MSS SP-78, Type II.
b. CWP Rating: 400 psig.
c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
d. Pattern: Regular or short.
e. Plug: Cast iron or bronze with sealant groove.

2.10 CHAINWHEELS

1. Manufacturers: Subject to compliance with requirements as indicated on the Drawings and specified herein.

2. Provide Trumbull Industries. Inc or equal product by one of the following:
3. Babbitt Steam Specialty Co.
4. Roto Hammer 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 plug valve stems.

3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve. Include zinc coating.

4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chain wheels on operators for ball gate and plug valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball or gate valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Throttling Service: ball valves.
4. Pump-Discharge Check Valves:

    a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
    b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-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.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-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 Steel Piping, NPS 2 and Smaller: Threaded ends.

5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.
7. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

D. For soldering lead free valves use a water based flux containing zinc chloride and ammonium chloride to prevent oxidization. Due to soldering difference in varying copper alloys, contact the manufacturer for best practices.

END OF SECTION 22 05 23

SECTION 22 05 29 – HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Refer to Section 22 05 00 – Common Work Results for Plumbing.

1.2 SUMMARY

A. This Section includes the following hangers and supports for plumbing system piping and equipment:

1. Steel 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 positioning systems.
9. Equipment supports.

B. Related Sections include the following:

1. Section 05 50 00 – Metal Fabrications for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.
3. Section 22 05 16 – Expansion Fittings and Loops for Plumbing Piping for pipe guides and anchors.
4. Section 22 05 48 – Vibration and Seismic Controls for Plumbing Piping and Equipment for vibration isolation devices.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Fiberglass pipe hangers.
3. Thermal-hanger shield inserts.
4. Powder-actuated fastener systems.
5. Pipe positioning 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 pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Fiberglass strut systems. Include Product Data for components.
4. Pipe stands. Include Product Data for components.
5. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel." AWS D1.4, "Structural Welding Code--Reinforcing Steel." ASME Boiler and Pressure Vessel Code: Section IX.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
4. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 **PRODUCTS**

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements as indicated on the Drawings and specified herein.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers: Provide Mason Industries or equal product by one of the following:

1. Michigan Hanger Co.
2. B-Line Systems
3. Grinnell Corp.
4. PHD Manufacturing, Inc.
5. Tolco Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

B. Manufacturers: Provide Mason Industries or equal product by one of the following:

1. Michigan Hanger Co.

2. B-Line Systems
3. Grinnell Corp.
4. PHD Manufacturing, Inc.
5. Tolco Inc.

2.4 FIBERGLASS PIPE HANGERS

A. Clevis-Type, Fiberglass Pipe Hangers: Similar to MSS Type 1, steel pipe hanger except hanger is made of fiberglass and continuous-thread rod and nuts are made of polyurethane.

B. Manufacturers: Provide Mason Industries or equal product by one of the following:

1. Michigan Hanger Co.
2. B-Line Systems
3. Grinnell Corp.
4. PHD Manufacturing, Inc.
5. Tolco Inc.
6. Cope, T. J., Inc.; Tyco International, Ltd.
7. Seasafe, Inc.
8. Unistrut Corp.; Tyco International, Ltd.
9. Wesanco, Inc.

C. Strap-Type, Fiberglass Pipe Hangers: Made of fiberglass loop with stainless-steel continuous-thread rod, nuts, and support hook.

1. Manufacturers
   a. Plasti-Fab, Inc.

2.5 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers: Provide Mason Industries or equal product by one of the following:

1. Michigan Hanger Co.
2. B-Line Systems
3. Grinnell Corp.
4. PHD Manufacturing, Inc.

5. Tolco Inc.

C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.6 FIBERGLASS STRUT SYSTEMS

A. Description: Shop- or field-fabricated pipe-support assembly, similar to MFMA-3, made of fiberglass channels and other components.

B. Manufacturers: Provide Mason Industries or equal product by one of the following:

1. Michigan Hanger Co.
2. B-Line Systems
3. Grinnell Corp.
4. PHD Manufacturing, Inc.
5. Tolco Inc.
6. Cope, T. J., Inc.; Tyco International, Ltd.
7. Seasafe, Inc.
8. Unistrut Corp.; Tyco International, Ltd.
9. Wesanco, Inc.

2.7 THERMAL-HANGER SHIELD INSERTS

2.8 DESCRIPTION: 100 PSIG MINIMUM, COMPRESSIVE-STRENGTH INSULATION INSERT ENCASED IN SHEET METAL SHIELD.

A. Manufacturers: Provide Mason Industries or equal product by one of the following:

1. Carpenter & Paterson, Inc.
2. Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.

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.

2.9 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: Provide Hilti Inc or equal product by one of the following:
    a. ITW Ramset/Red Head
    b. Masterset Fastening Systems, Inc.
    c. MKT Fastening, LLC

B. Powers Fasteners

C. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, 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: Provide Hilti Inc or equal product by one of the following:
    a. B-Line Systems, Inc.; a division of Cooper Industries.
    b. Empire Industries, Inc.
    c. ITW Ramset/Red Head
    d. MKT Fastening, LLC
    e. Powers Fasteners

2.10 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.

B. Manufacturers: Provide HOLDRITE Corp.; Hubbard Enterprises or equal product by one of the following:

1. C & S Mfg. Corp.
2. Samco Stamping, Inc.

2.11 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.12 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, 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**

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified 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 padded hangers for piping that is subject to scratching.

1. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
2. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
3. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 degrees F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
4. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
5. 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.

6. 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.
7. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
8. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
9. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
10. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
11. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
12. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
13. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
14. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
15. 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.
16. 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 and with U-bolt to retain pipe.
17. 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.
18. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
19. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
20. 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.
21. 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.
22. 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.

F. 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 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

G. 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 degrees 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 degrees F piping installations.

H. 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.

I. 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.

J. 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 absorb 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 absorb 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 absorb 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.

K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

M. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

N. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel 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 building structure.

B. 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 above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Fiberglass Pipe Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled fiberglass struts.

F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

G. 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.

H. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.

I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

K. 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.

L. Install lateral bracing with pipe hangers and supports to prevent swaying.

M. 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.

N. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

P. Insulated Piping: Comply with the following:

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 according to 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: 24 inches long and 0.075-inch thick.

5. Pipes NPS 8 and Larger: Include wood inserts.

6. Insert Material: Length at least as long as protective shield.

7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 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 contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touch Up: 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. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 22 05 29

SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Refer to Section 22 05 00 – Common Work Results for Plumbing.

1.2 SUMMARY

A. Section Includes

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Valve tags.
5. Warning tags.

1.3 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.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS AS INDICATED ON THE DRAWINGS AND SPECIFIED HEREIN:

A. Provide Brady inc. pipe markers or equal product by one of the following:

1. Seton Inc
2. Craftmark Pipe Markers

2.2 EQUIPMENT LABELS

A. Metal Labels for Equipment

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
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-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets.
8. 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), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.3 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. 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.

G. Fasteners: Stainless-steel rivets.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.4 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 partially cover 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.

2.5 VALVE TAGS

A. 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 minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Section 09 91 23 – Interior 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, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. 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 10 feet along each run. Reduce to every 5 feet in areas of congested piping and equipment.

D. Pipe Label Color Schedule

1. Low-Pressure, Compressed-Air Piping

a. Background Color: Green.
b. Letter Color: Black.

2. Domestic Water Piping

a. Background Color: Blue for domestic cold water and Red for domestic hot water supply and return.
b. Letter Color: Black.

3. Sanitary Waste and Storm Drainage Piping

a. Background Color: Yellow.
b. Letter Color: Black.

3.4 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. Cold Water: 1-1/2 inches, round.
    b. Hot Water: 1-1/2 inches, round.
    c. Low-Pressure Compressed Air: 1-1/2 inches, round.

2. Valve-Tag Color

    a. Cold Water: Natural.
    b. Hot Water: Natural.
    c. Low Pressure Compressed Air: Natural.

3. Letter Color

    a. Cold Water: Black.
    b. Hot Water: Black.
    c. Low Pressure Compressed Air: Black.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 22 05 53

SECTION 22 07 00 - PLUMBING INSULATION

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. Refer to Section 22 05 00 – Common Work Results for Plumbing.

1.2 SUMMARY

A. Section Includes

1. Insulation Materials

    a. Calcium silicate.
    b. Cellular glass.
    c. Flexible elastomeric.
    d. Mineral fiber.

2. Adhesives.
3. Mastics.
4. Lagging adhesives.
5. Sealants.
6. Factory-applied jackets.
7. Tapes.

B. Related Sections include the following:

1. Section 21 07 00 – Fire Suppression Systems Insulation.
2. Section 23 07 00 – HVAC Insulation.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. LEED Submittal

1. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.

C. Shop Drawings

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.
8. Detail field application for each equipment type.

D. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Sample Sizes

a. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
b. Sheet Form Insulation Materials: 12 inches square.
c. Jacket Materials for Pipe: 12 inches long by NPS 2.
d. Sheet Jacket Materials: 12 inches square.
e. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

E. Qualification Data: For qualified Installer.

F. 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.

G. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment.

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment 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.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. 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. Products: Subject to compliance with requirements, provide Pittsburgh Corning Corporation; Foamglas Super K. or equal product by one of the following:

    a. Cell-U-Foam Corporation; Ultra-CUF.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
6. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

    a. Products: Subject to compliance with requirements, provide Armacell LLC; AP Armaflex or equal product by one of the following:
    b. Aeroflex USA Inc.; Aerocel.
    c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180

G. Mineral-Fiber, Preformed Pipe Insulation

1. Products: Subject to compliance with requirements as indicated on the drawings, provide Johns Manville Insulation or equal product by one of the following:

    a. CertainTeed Corp.
    b. Knauf Insulation
    c. Owens Corning Insulation

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. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements as indicated on the drawings, provide Johns Manville Insulation or equal product by one of the following:

    a. CertainTeed Corp.
    b. Knauf Insulation
    c. Owens Corning Insulation

2.2 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. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.

1. Products: Subject to compliance with requirements, provide Childers Products, Division of ITW; CP-97 or equal product by one of the following.

    a. Foster Products Corporation, H. B. Fuller Company; 81-27/81-93.
    b. Marathon Industries, Inc.; 290.
    c. Mon-Eco Industries, Inc.; 22-30.
    d. Vimasco Corporation; 760.

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).

C. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 degrees F.

1. Products: Subject to compliance with requirements, provide Childers Products, Division of ITW; CP-96. Or equal product by one of the following:

    a. Foster Products Corporation, H. B. Fuller Company; 81-33.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide Childers Products, Division of ITW; CP-82 or equal product by one of the following:

    a. Foster Products Corporation, H. B. Fuller Company; 85-20.
    b. ITW TACC, Division of Illinois Tool Works; S-90/80.
    c. Marathon Industries, Inc.; 225.
    d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide Childers Products, Division of ITW; CP-82 or equal product by one of the following:

    a. Foster Products Corporation, H. B. Fuller Company; 85-20.

b. ITW TACC, Division of Illinois Tool Works; S-90/80.
c. Marathon Industries, Inc.; 225.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide Dow Chemical Company (The); 739, Dow Silicone or equal product by one of the following:

a. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
b. P.I.C. Plastics, Inc.; Welding Adhesive.
c. Speedline Corporation; Speedline Vinyl Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide Childers Products, Division of ITW; CP-35 or equal product by one of the following:

a. Foster Products Corporation, H. B. Fuller Company; 30-90.
b. ITW TACC, Division of Illinois Tool Works; CB-50.
c. Marathon Industries, Inc.; 590.
d. Mon-Eco Industries, Inc.; 55-40.
e. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 degrees F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

2.4 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. Products: Subject to compliance with requirements, provide Childers Products, Division of ITW; CP-52. Or equal product by one of the following:

a. Foster Products Corporation, H. B. Fuller Company; 81-42.
b. Marathon Industries, Inc.; 130.
c. Mon-Eco Industries, Inc.; 11-30.
d. Vimasco Corporation; 136.

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
3. Service Temperature Range: Minus 50 to plus 180 degrees F.
4. Color: White.

2.5 SEALANTS

A. Joint Sealants

1. Joint Sealants for Cellular-Glass, Products: Subject to compliance with requirements, provide Childers Products, Division of ITW; CP-76 or equal product by one of the following:

a. Foster Products Corporation, H. B. Fuller Company; 30-45.
b. Marathon Industries, Inc.; 405.
c. Mon-Eco Industries, Inc.; 44-05.
d. Pittsburgh Corning Corporation; Pittseal 444.
e. Vimasco Corporation; 750.

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 degrees F.
5. Color: White or gray.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants

1. Products: Subject to compliance with requirements, provide the following:

a. Childers Products, Division of ITW; CP-76-8.
b. Foster Products Corporation, H. B. Fuller Company; 95-44.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Vimasco Corporation; 750.

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 degrees F.
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants

1. Products: Subject to compliance with requirements, provide the following:

   a. Childers Products, Division of ITW; CP-76.

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 degrees F.
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

   a. Products: Subject to compliance with requirements, provide the following:

      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

5. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

   a. Products: Subject to compliance with requirements, provide the following:

      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.7 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 Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835. Or equal product by one of the following:

    a. Compac Corp.; 104 and 105.
    b. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
    c. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

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. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    b. Compac Corp.; 110 and 111.
    c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
    d. Venture Tape; 1525 CW, 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.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide the following:

    a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    b. Compac Corp.; 120.
    c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
    d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

D. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide the following:

a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.

2. Width: 3 inches.
3. Film Thickness: 4 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use de-mineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and 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.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer 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.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 07 84 13 – 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 07 84 13 – Penetration Firestopping.

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
    d. Do not overcompress insulation during installation.
    e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    f. Impale insulation over anchor pins and attach speed washers.
    g. 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.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.

6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

3.6 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, vessels, and equipment. 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.

3.7 CELLULAR-GLASS INSULATION INSTALLATION

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 but 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.

3.8 MINERAL-FIBER INSULATION INSTALLATION

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 but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 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; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. 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.

E. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fish mouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.10 FINISHES

A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

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. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.11 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 field-insulated equipment, 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 one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
2. 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.

3.12 EQUIPMENT INSULATION SCHEDULE

A. Retain "one of" option in paragraphs in this article to allow Contractor to select piping materials from those retained.

B. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

C. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.

D. Heat-exchanger (water-to-water for domestic water heating service) insulation shall be one of the following:

1. Calcium Silicate: 3 inches thick.

2. Cellular Glass: 3 inches thick.
3. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
4. Mineral-Fiber Pipe and Tank: 2 inches thick.

E. Steam-to-hot-water heat exchanger insulation shall be one of the following:

1. Calcium Silicate: 3 inches thick.
2. Cellular Glass: 3 inches thick.
3. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
4. Mineral-Fiber Pipe and Tank: 2 inches thick.

F. Domestic hot-water hydro-pneumatic tank insulation shall be one of the following:

1. Cellular Glass: 1-1/2 inches thick.
2. Flexible Elastomeric: 1 inch thick.
3. Mineral-Fiber Board: 1 inch thick and 3-lb/cu. ft. nominal density.
4. Mineral-Fiber Pipe and Tank: 1 inch thick.

G. Domestic hot-water storage tank insulation shall be one of the following, of thickness to provide an R-value of 12.5:

1. Cellular glass.
2. Mineral-Fiber Board: 3-lb/cu. ft. nominal density.
3. Mineral-fiber pipe and tank.

H. Domestic water storage tank insulation shall be one of the following:

1. Cellular Glass: 2 inches thick.
2. Flexible Elastomeric: 1 inch thick.
3. Mineral-Fiber Board: 1 inch thick and 3-lb/cu. ft. nominal density.
4. Mineral-Fiber Pipe and Tank: 1 inch thick.

3.13 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.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.14 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water: As required by project location. Refer to drawings for additional information.

1. NPS 1 and Smaller: Insulation shall be one of the following:

    a. Cellular Glass: 1-1/2 inches thick.
    b. Flexible Elastomeric: 1 inch thick.
    c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

2. NPS 1-1/4 and Larger: Insulation shall be one of the following:

    a. Cellular Glass: 1-1/2 inches thick.
    b. Flexible Elastomeric: 1 inch thick.
    c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:

    a. Cellular Glass: 1-1/2 inches thick.
    b. Flexible Elastomeric: 1 inch thick.
    c. 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. Flexible Elastomeric: 1 inch thick.
    c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. 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.

D. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation shall be one of the following:

    a. Cellular Glass: 2 inches thick.
    b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

E. 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. Flexible Elastomeric: 1 inch thick.
    c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

F. 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. Flexible Elastomeric: 1 inch thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

END OF SECTION 22 07 00

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Refer to Section 22 05 00 – Common Work Results for Plumbing.

1.2 SUMMARY

A. Section Includes

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Encasement for piping.
3. Specialty valves.
4. Flexible connectors.
5. Water meters.
6. Escutcheons.
7. Sleeves
8. Sleeve seals.
9. Wall penetration systems.

B. Related Section

C. General: Refer to Section 22 05 00 - COMMON WORK RESULTS FOR PLUMBING.

1. PERFORMANCE REQUIREMENTS

D. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to ASCE/SEI 7.

E. Contractor / Facility Coordinator to supply potable water supply and fittings appropriate for connection to the Fuel Bar and equipment described.

1.3 SUBMITTALS

A. Product Data: For the following products:

1. Specialty valves.
2. Flexible connectors.
3. Backflow preventers and vacuum breakers.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.

C. Comply with NSF 61 for potable domestic water piping and components.

1.5 PROJECT 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 Construction Manager no fewer than two days in advance of proposed interruption of water service.
2. Do not proceed with interruption of water service without Construction Manager's written permission.

1.6 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.7 LEAD FREE INSTALLATION

A. The contractor shall install only products that comply with the requirements as described in State Assembly Bill AB-1953 for lead free products. Submit all lead free products to be installed to the engineer for review.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, drawn temper, Type L for domestic water and ASTM B 88, Type M water tube for condensate drains.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.

2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Elkhart Products Corporation; Industrial Division
        2) NIBCO INC.

5. Grooved-Joint Copper-Tube Appurtenances

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Anvil International
        2) Shurjoint Piping Products
        3) Victaulic Company

    b. Copper Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.

    c. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.

B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.

1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; 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. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

E. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.

1. Use CPVC solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.4 SPECIALTY VALVES

A. Comply with requirements in Section 22 05 23 – General Duty Valves for Plumbing Piping for general-duty metal valves.

B. Comply with requirements in Section 22 11 19 – Domestic Water Piping Specialties for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.5 TRANSITION FITTINGS

A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

2.6 DIELECTRIC FITTINGS

A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

2.7 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flex-Hose Co., Inc.
2. Flexicraft Industries
3. Flex Pression, Ltd.
4. Flex-Weld, Inc.
5. Hyspan Precision Products, Inc.
6. Mercer Rubber Co.
7. Metraflex, Inc.
8. Proco Products, Inc.
9. Tozen Corporation
10. Unaflex, Inc.
11. Universal Metal Hose; a Hyspan company

B. 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.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.8 ESCUTCHEONS

A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

2.9 SLEEVES

A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

2.10 SLEEVE SEALS

A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

2.11 WALL PENETRATION SYSTEMS

A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

2.12 GROUT

A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 31 20 00 – Earth Moving for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105.

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 in Section 22 05 19 – Meters and Gages for Plumbing Piping for pressure gages and Section 22 11 19 – Domestic Water Piping Specialties for drain valves and strainers.

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Section 22 11 19 – Domestic Water Piping Specialties for pressure-reducing valves.

H. Install domestic water piping level 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 in Section 22 05 48 – Vibration and Seismic Controls for Plumbing Piping and Equipment for seismic-restraint devices.

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 adjacent to equipment and specialties to allow service and maintenance.

O. Install piping to permit valve servicing.

P. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

Q. Install piping free of sags and bends.

R. Install fittings for changes in direction and branch connections.

S. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

T. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Section 22 05 19 – Meters and Gages for Plumbing Piping for pressure gages.

U. Install thermostats in hot-water circulation piping. Comply with requirements in Section 22 11 23 – Domestic Water Pumps for thermostats.

V. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Section 22 05 19 – Meters and Gages for Plumbing Piping for thermometers.

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

E. Soldered Joints: 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. Copper-Tubing Grooved Joints: Roll groove end of tube. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for roll-grooved joints.

G. 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.

H. 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. Apply primer.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Section 22 05 23 – General Duty Valves for Plumbing Piping for valve installations.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Section 22 11 19 – Domestic Water Piping Specialties.

1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

D. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Section 22 11 19 – Domestic Water Piping Specialties for calibrated balancing valves.

3.5 TRANSITION FITTING INSTALLATION

A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

3.6 DIELECTRIC FITTING INSTALLATION

A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

3.7 FLEXIBLE CONNECTOR INSTALLATION

A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.

B. Install bronze-hose flexible connectors in copper domestic water tubing.

C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.8 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Section 22 05 48 – Vibration and Seismic Controls for Plumbing Piping and Equipment for seismic restraint devices.

B. Comply with requirements Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment for pipe hanger and support products and installation.

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.

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

H. Install supports for vertical steel piping every 15 feet.

I. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1 and Smaller: 36 inches with 3/8-inch rod.
2. NPS 1-1/4 to NPS 2: 48 inches with 3/8-inch rod.
3. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
4. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
5. NPS 6: 48 inches with 3/4-inch rod.

J. Install supports for vertical CPVC piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.

K. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2 and Smaller: 48 inches with 3/8-inch rod.
2. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.

3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6: 48 inches with 3/4-inch rod.

L. Install supports for vertical PVC piping every 48 inches.

M. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.9 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow 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 required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
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.

3.10 ESCUTCHEON INSTALLATION

A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

3.11 SLEEVE INSTALLATION

A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

3.12 SLEEVE SEAL INSTALLATION

A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

3.13 WALL PENETRATION SYSTEM INSTALLATION

A. General: Refer to Section 22 05 00 – Common Work Results for Plumbing.

3.14 IDENTIFICATION

A. Identify system components. Comply with requirements in Section 22 05 53 – Identification for Plumbing Piping and Equipment for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.15 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. 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:

    a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. 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.
3. 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.
4. 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 to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
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 for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.16 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 flow of hot water 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.

3.17 CLEANING

A. Clean and disinfect potable and 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 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.

3. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

4. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

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.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.18 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 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 ball valves with flanged ends for piping NPS 2-1/2 and larger.
3. Hot-Water Circulation Piping, Balancing Duty: Calibrated with Memory stop.
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.

D. CPVC valves matching piping materials may be used.

END OF SECTION 22 11 16

SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Refer to Section 22 05 00 – Common Work Results for Plumbing.

1.2 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Temperature-actuated water mixing valves.
5. Strainers.
6. Outlet boxes.
7. Hose bibbs.
8. Wall hydrants.
9. Water hammer arresters.
10. Air vents.
11. Trap-seal primer valves.
12. Trap-seal primer systems.

B. Related Sections include the following:

1. Section 22 05 19 – Meters and Gages for Plumbing Piping for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 22 11 16 – Domestic Water Piping for water meters.
3. Section 22 45 00 – Emergency Plumbing Fixtures for water tempering equipment.
4. Section 22 47 00 – Drinking Fountains and Water Coolers for water filters for water coolers.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Compliance

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers

1. Manufacturers: Subject to compliance with requirements, provide Watts Industries, Inc.; Water Products Div. or equal product by one of the following:

    a. Ames Co.
    b. Cash Acme
    c. ConBraCo Industries, Inc.
    d. FEBCO; SPX Valves & Controls
    e. Zurn Plumbing Products Group; Wilkins Div.

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.

B. Hose-Connection Vacuum Breakers

1. Manufacturers: Subject to compliance with requirements, provide Watts Industries, Inc.; Water Products Div. or equal product by one of the following:

    a. Arrowhead Brass Products, Inc.

b. Cash Acme
c. ConBraCo Industries, Inc.
d. Legend Valve
e. MIFAB, Inc.
f. Prier Products, Inc
g. Woodford Manufacturing Company
h. Wilkins Valve Div.

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. Spill-Resistant Vacuum Breakers

1. Manufacturers: Subject to compliance with requirements, provide Watts Industries, Inc.; Water Products Div. or equal product by one of the following:

a. ConBraCo Industries, Inc.

2. Standard: ASSE 1056.
3. Operation: Continuous-pressure applications.
4. Size: Refer to floor plans
5. Accessories

a. Valves: Ball type, on inlet and outlet.

2.2 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers. Refer to equipment schedule for equipment type:

1. Manufacturers: Subject to compliance with requirements, provide Watts Industries, Inc.; Water Products Div. or equal product by one of the following:

a. Cash Acme
b. ConBraCo Industries, Inc.
c. FEBCO; SPX Valves & Controls
d. Wilkins Valve Div.

2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
4. Size: Refer to equipment schedule
5. Body: Bronze.
6. End Connections: Union, solder joint.
7. Finish: Chrome plated.

B. Reduced-Pressure-Principle Backflow Preventers. Refer to equipment schedule for equipment type:

1. Manufacturers: Subject to compliance with requirements, provide Watts Industries, Inc.; Water Products Div. or equal product by one of the following:

    a. Ames Co.
    b. ConBraCo Industries, Inc.
    c. FEBCO; SPX Valves & Controls
    d. Flomatic Corporation
    e. Wilkins Valve Div.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Size: Refer to equipment schedule
6. Design Flow Rate: Refer to equipment schedule
7. Body: lead free brass.
8. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
9. Configuration: Designed for horizontal, straight through flow.
10. Accessories

    a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
    b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Beverage-Dispensing-Equipment Backflow Preventers: Refer to equipment schedule for equipment type:

1. Manufacturers: Subject to compliance with requirements, provide Watts Industries, Inc.; Water Products Div. or equal product by one of the following:

    a. ConBraCo Industries, Inc.
    b. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1022.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8.
5. Body: Stainless steel.
6. End Connections: Threaded.

D. Hose-Connection Backflow Preventers: Refer to equipment schedule for equipment type.

1. Manufacturers: Subject to compliance with requirements, provide Watts Industries, Inc.; Water Products Div. or equal product by one of the following:

a. ConBraCo Industries, Inc.
b. Woodford Manufacturing Company

2. Standard: ASSE 1052.
3. Operation: Up to 10-foot head of water back pressure.
4. Inlet Size: NPS 1/2 or NPS 3/4.
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3 gpm flow.

E. Backflow-Preventer Test Kits

1. Manufacturers: Subject to compliance with requirements, provide ConBraCo Industries, Inc. or equal product by one of the following:

a. FEBCO; SPX Valves & Controls
b. Flomatic Corporation
c. Watts Industries, Inc.; Water Products Div.
d. Zurn Plumbing Products Group; Wilkins Div.

2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.3 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices Refer to equipment schedule for equipment type.

1. Manufacturers: Subject to compliance with requirements, provide Powers; a Watts Industries Co or equal product by one of the following:

a. Leonard Valve Company
b. Symmons Industries, Inc.
c. Watts Industries, Inc.; Water Products Div.
d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded with unions on inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: Refer to equipment schedule.
9. Tempered-Water Design Flow Rate: Refer to equipment schedule.
10. Valve Finish: Rough bronze.

B. Primary, Thermostatic, Water Mixing Valves: Refer to equipment schedule for equipment type.

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:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

    a. Armstrong International, Inc.
    b. Lawler Manufacturing Company, Inc.
    c. Leonard Valve Company
    d. Powers; a Watts Industries Co.
    e. Symmons Industries, Inc.

4. Standard: ASSE 1017.
5. Pressure Rating: 125 psig.
6. Type: Exposed-mounting, thermostatically controlled water mixing valve.
7. Material: Bronze body with corrosion-resistant interior components.
8. Connections: Threaded with unions on inlets and outlet.
9. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
10. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
11. Tempered-Water Setting: Refer to equipment schedule.
12. Tempered-Water Design Flow Rate: Refer to equipment schedule.
13. Valve Finish: Rough bronze.
14. Piping Finish: Copper.

2.4 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers Refer to equipment schedule for equipment type.

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron 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-inch.
    b. Strainers NPS 2-1/2 to NPS 4: 0.045-inch.

6. Drain: Pipe plug.

2.5 HOSE BIBBS

A. Hose Bibbs Refer to equipment schedule for equipment type:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.6 WALL HYDRANTS

A. Moderate-Climate Wall Hydrants: Refer to equipment schedule for equipment type.

1. Manufacturers: Subject to compliance with requirements, provide Woodford Manufacturing Company or equal product by one of the following:

    a. Josam Company
    b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    c. Tyler Pipe; Wade Div.
    d. Watts Drainage Products Inc.
    e. Zurn Plumbing Products Group; Specification Drainage Operation

2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Inlet: NPS 3/4 or NPS 1.
6. Outlet: Concealed, with integral vacuum breaker or non removable hose-connection vacuum breaker complying with ASSE 1011; and garden-hose thread complying with ASME B1.20.7.
7. Box: Deep, flush mounting with cover.
8. Box and Cover Finish: Rough Chrome plated.
9. Outlet: Exposed, with integral vacuum breaker or nonremovable hose-connection vacuum breaker complying with ASSE 1011; and garden-hose thread complying with ASME B1.20.7.
10. Operating Keys(s): Two with each wall hydrant.

2.7 WATER HAMMER ARRESTERS

A. Water Hammer Arresters: Refer to equipment schedule for equipment type.

1. Manufacturers: Subject to compliance with requirements, provide Precision Plumbing Products Inc. or equal product by one of the following:

    a. Josam Company
    b. Sioux Chief Manufacturing Company, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.8 AIR VENTS

A. Bolted-Construction Automatic Air Vents: Refer to equipment schedule for equipment type.

1. Body: Bronze.
2. Pressure Rating: 125 psig minimum pressure rating at 140 degrees F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 1/2 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents: Refer to equipment schedule for equipment type.

1. Body: Stainless steel.
2. Pressure Rating: 150 psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.9 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves: Refer to equipment schedule for equipment type.

1. Manufacturers: Subject to compliance with requirements, provide Precision Plumbing Products Inc. or equal product by one of the following:

    a. Sioux Chief Manufacturing Company, Inc.
    b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    c. Watts Industries, Inc.; Water Products Div.

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: Rough bronze.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Section 22 05 00 – Common Work Results for Plumbing for piping joining materials, joint construction, and basic installation requirements.

B. 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 not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

C. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

D. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

E. Install balancing valves in locations where they can easily be adjusted.

F. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers and water regulators if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified.

G. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

H. Install outlet boxes recessed in wall. Install 2-inch by-4-inch fire retardant treated wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Section 06 10 00 – Rough Carpentry.

I. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.

1. Install shutoff valve on outlet if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-inch by-4-inch fire retardant treated wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Section 06 10 00 – Rough Carpentry.

J. Install water hammer arresters in water piping according to PDI-WH 201.

K. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

L. Install supply-type, trap-seal primer valves 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.

M. Install trap-seal primer systems 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.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Section 26 05 26 – Grounding and Bonding for Electrical Systems.

C. Connect wiring according to Section 26 05 19 – Low Voltage Electrical Power Conductors and Cables.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: 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. Water pressure-reducing valves.
6. Calibrated balancing valves.
7. Primary, thermostatic, water mixing valves.
8. Primary water tempering valves.
9. Outlet boxes.
10. Hose stations.
11. Supply-type, trap-seal primer valves.
12. 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 22 05 53 – Identification for Plumbing Piping and Equipment.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each vacuum breaker reduced-pressure-principle backflow preventer double-check backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 22 11 19

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Refer to Section 22 05 00 – Common Work Results for Plumbing.

1.2 SUMMARY

A. This Section includes the following piping inside the building:

1. Sanitary Waste and Vent
2. Pipe, tube, and fittings.
3. Special pipe fittings.
4. Sanitary Sewer, Force-Main Piping
5. Encasement for underground metal piping.

B. Related Sections include the following:

1. Section 22 13 29 – Sanitary Sewerage Pumps
2. Section 22 66 00 – Chemical Waste Systems for Laboratory and Healthcare Facilities for chemical-waste and vent piping systems.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. LLDPE: Linear, low-density polyethylene plastic.

D. NBR: Acrylonitrile-butadiene rubber.

E. PE: Polyethylene plastic.

F. PVC: Polyvinyl chloride plastic.

G. TPE: Thermoplastic elastomer.

1.4 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. Sanitary Sewer, Force-Main Piping: 100 psig.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. LEED Submittal

1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.

C. Shop Drawings

1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.

D. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. 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; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

C. All cast iron pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

a. Manufacturers

1) ANACO.
2) Ideal Div.; Stant Corp.
3) Mission Rubber Co.
4) Tyler Pipe; Soil Pipe Div.

2. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

a. Manufacturers

1) ANACO.
2) Clamp-All Corp.
3) Ideal Div.; Stant Corp.
4) Mission Rubber Co.
5) Tyler Pipe; Soil Pipe Div.

3. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.

a. Manufacturers

1) MG Piping Products Co.

C. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers

a. ANACO.

2.4 SPECIAL PIPE FITTINGS

A. Flexible, Non pressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers

a. Dallas Specialty & Mfg. Co.
b. Fernco, Inc.
c. Logan Clay Products Company (The).
d. Mission Rubber Co.
e. NDS, Inc.

2. Sleeve Materials

a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.

B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers

a. Cascade Waterworks Mfg. Co.
b. Mission Rubber Co.

C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers

a. ANACO.

D. Flexible Ball Joints: Ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include gasketed ball-joint section and ductile-iron gland, rubber gasket, and steel bolts.

1. Manufacturers

a. EBAA Iron Sales, Inc.

E. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with

AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Manufacturers

    a. EBAA Iron Sales, Inc.
    b. Romac Industries, Inc.
    c. Star Pipe Products; Star Fittings Div.

F. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Manufacturers

    a. SIGMA Corp.

2.5 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Description: ASTM A 674 or AWWA C105, high-density, cross laminated PE film of 0.004-inch minimum thickness.

B. Form: tube.

C. Color: Black.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Section 31 20 00 – Earth Moving for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground, soil, waste and vent piping shall be any of the following:

1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
2. Steel pipe, drainage fittings, and threaded joints.
3. Copper DWV tube, copper drainage fittings, and soldered joints.
4. Dissimilar Pipe-Material Couplings: Shielded, non pressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

C. Underground, soil, waste, and vent piping shall be any of the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. Solid wall ABS pipe, ABS socket fittings, and solvent-cemented joints.

3. Dissimilar Pipe-Material Couplings: Shielded, non pressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

D. Aboveground sanitary-sewage force mains shall be any of the following:

1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
2. Steel pipe, pressure fittings, and threaded joints.

E. Underground sanitary-sewage force mains shall be any of the following:

1. Hard copper tube, Type L; wrought-copper pressure fittings; and soldered joints.
2. Steel pipe, pressure fittings, and threaded joints.
3. Pressure pipe couplings, if dissimilar pipe materials or piping with small difference in OD must be joined.

3.3 PIPING INSTALLATION

A. Sanitary sewer piping outside the building is specified in Section 22 13 13 – Facility Sanitary Sewers.

B. Basic piping installation requirements are specified in Section 22 05 00 – Common Work Results for Plumbing.

C. Install seismic restraints on piping. Seismic-restraint devices are specified in Section 22 05 48 – Vibration and Seismic Controls for Plumbing Piping and Equipment.

D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

E. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

F. Install underground, steel, force-main piping. Install encasement on piping according to ASTM A 674 or AWWA C105.

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

G. 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.

H. Install underground, ductile-iron, special pipe fittings according to AWWA C600.

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

I. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Section 22 05 00 – Common Work Results for Plumbing.

J. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.

K. 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.

L. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. 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. Use long-turn, double Y-branch and 1/8 bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

M. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

N. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow unless otherwise indicated on drawings.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow unless otherwise indicated on drawings.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

O. Install engineered soil and waste drainage and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.

P. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

Q. Install ABS soil and waste drainage and vent piping according to ASTM D 2661.

R. Install underground ABS soil and waste drainage piping according to ASTM D 2321.

S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Section 22 05 00 – Common Work Results for Plumbing.

B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

C. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

D. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Section 22 05 23 – General Duty Valves for Plumbing Piping.

B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.

1. Install full-port ball valve for piping NPS 2 and smaller.
2. 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.

3.6 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Section 22 05 48 – Vibration and Seismic Controls for Plumbing Piping and Equipment.

B. Pipe hangers and supports are specified in Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment. Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Install individual, straight, horizontal piping runs according to the following:

    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. Install supports according to Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6: 60 inches with 3/4-inch rod.
5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.

I. Install supports for vertical steel piping every 15 feet.

J. 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 to 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.

K. Install supports for vertical copper tubing every 10 feet.

L. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage 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 drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. 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 or sanitary manhole.
2. Sewage Pumps: To sewage pump discharge.

3.8 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. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage 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. 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 drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. 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. 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. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. 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. 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. Isolate test source and allow to stand for four hours. 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.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PROTECTION

A. Exposed ABS Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 22 13 16

SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Refer to Section 22 05 00 – Common Work Results for Plumbing.

1.2 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Backwater valves.
2. Floor drains.
3. Floor Sinks.
4. Planter Drains.
5. Trench drains.
6. Indirect Waste Receptors
7. Clean Outs.
8. Air-admittance valves.
9. Roof flashing assemblies.
10. Through-penetration firestop assemblies.
11. Miscellaneous sanitary drainage piping specialties.
12. Flashing materials.

B. Related Sections include the following:

1. Section 22 14 23 – Storm Drainage Piping Specialties for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

F. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:

1. Backwater valves.
2. Cleanouts.
3. Floor drains.
4. Trench drains.
5. Air-admittance valves.
6. Roof flashing assemblies.
7. Through-penetration firestop assemblies.
8. Miscellaneous sanitary drainage piping specialties.
9. Flashing materials.

B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

1.7 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.

PART 2 - PRODUCTS

2.1 FLOOR DRAINS

A. Manufacturers: Subject to compliance with requirements, provide Zurn Industries or equal product by one of the following:

B. Provide Zurn Plumbing Products or equal product by one of the following:

1. Commercial Enameling Co.
2. Josam Company
3. MIFAB, Inc.
4. Smith, Jay R. Mfg. Co.
5. Tyler Pipe; Wade Div.
6. Watts Drainage Products Inc.

C. Floor Drain: FD-1

1. Make and Model: Zurn Industries Model Z-415-2NH-5S-P
2. Description: Dura Coated Cast Iron body, bottom outlet, combination membrane clamp with adjustable collar and trap primer connection.
3. Strainer type: 5” nickel bronze square secured top.
4. Connection Type: 2” no hub connection.

2.2 FLOOR SINKS

A. Manufacturers: Subject to compliance with requirements, provide Zurn Industries Floor Sinks as described herein:

B. Provide Zurn Plumbing Products or equal product by one of the following:

1. Commercial Enameling Co.
2. Josam Company
3. MIFAB, Inc.
4. Smith, Jay R. Mfg. Co.
5. Tyler Pipe; Wade Div.
6. Watts Drainage Products Inc.

C. Floor Sink: FS-1

1. Make and Model: Zurn Industries Model Z-1910-2NH-2-P
2. Description: White acid resisting porcelain enamel interior and top, bottom outlet, 8-inch by 8-inch square body, 6-inch deep, flashing clamp and trap primer connection.
3. Grate type: Medium duty slotted, 6-inch square half grate, white acid resisting porcelain enamel coating.
4. Connection Type: 2-inch no hub connection.

2.3 INDIRECT WASTE RECEPTORS

A. Manufacturers: Subject to compliance with requirements, provide Zurn Industries or equal product by one of the following:

1. Josam Company
2. MIFAB, Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.
6. Indirect Waste Receptor: IWR-1. Roof top units

    a. Make and Model: Zurn Industries Model Z-127-2NH.
    b. Description: 8-1/2-inch diameter, Dura Coated Cast Iron Body, combination membrane flashing clamp, no hub inlet.
    c. Strainer type: Internal Dome Strainer with 2-inch high water dam.
    d. 2-inch outlet minimum. Verify pipe size connection indicated on floor plans.

7. Indirect Waste Receptor: IWR-2. Cooling towers

    a. Make and Model: Zurn Industries Model Z-122-3NH.
    b. Description: 12-inch diameter, Dura Coated Cast Iron Body, combination membrane flashing clamp, no hub inlet.
    c. Strainer type: Internal Dome Strainer with 2-inch high water dam.
    d. 3-inch outlet minimum. Verify pipe size connection indicated on floor plans.

2.4 CLEANOUTS

A. Manufacturers: Subject to compliance with requirements, provide Zurn Plumbing Products or equal product by one of the following:

1. Josam Company
2. MIFAB, Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.

B. Floor Cleanout: FCO-1

1. Make and Model: Zurn industries Model Z-1400-NH
2. Description: Dura coated Cast Iron body, adjustable top, no hub connection, round top, brass tapered threaded plug.
3. Pipe size connection as indicated on floor plans.

C. Wall Cleanout: WCO-1

1. Make and Model: Zurn industries Model Z-1441-NH

2. Description: Dura coated Cast Iron body, adjustable top, no hub connection, smooth stainless steel cover plate with securing screw and brass tapered threaded plug.
3. Pipe size connection as indicated on floor plans.

2.5 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Fire stop Assemblies

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. ProSet Systems Inc.

2. Standard: UL 1479 assembly of sleeve and stack fitting with fire stopping 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.

2.6 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

B. Air-Gap Fittings

1. An in-line air gap fitting at the P-Trap may be used if an indirect waste floor sink installation is prohibitive. Equipment required to be plumbed to an air-gap (Ice maker and dishwasher) should be coordinated to installation before proceeding with this option.
2. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
3. Body: Bronze or cast iron.
4. Inlet: Opening in top of body.
5. Outlet: Larger than inlet.
6. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
7. Josam Model 88120 or prior approved equal.

C. Sleeve Flashing Device

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

D. Stack Flashing Fittings

1. Description: 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.

E. Vent Caps

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

F. Expansion Joints

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

2.7 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft..
2. Vent Pipe Flashing: 8 oz./sq. ft..

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40 mil minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Section 22 05 00 – Common Work Results for Plumbing for piping joining materials, joint construction, and basic installation requirements.

B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

C. 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.

D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. 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. 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.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

G. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.

H. Assemble FRP channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

I. Install fixture air-admittance valves on fixture drain piping.

J. Install stack air-admittance valves at top of stack vent and vent stack piping.

K. Install air-admittance-valve wall boxes recessed in wall.

L. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

M. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

N. Install through-penetration fire stop assemblies for stacks at floor penetrations.

O. Assemble open drain fittings and install with top of hub 36 inches above floor.

P. Install floor-drain and floor sink, trap-seal primer fittings on inlet to floor drains and floor sinks that require trap-seal primer connection.

1. Size: Same as floor drain inlet. Refer to floor plans for location.

Q. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

R. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

S. Install vent caps on each vent pipe passing through roof.

T. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

U. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

V. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. 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 26 05 26 – Grounding and Bonding for Electrical Systems.

D. Connect wiring according to Section 26 05 19 – Low Voltage Electrical Power Conductors and Cables.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. 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.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counter flashing or commercially made flashing fittings, according to Section 07 62 00 – Sheet Metal Flashing and Trim.

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign next to equipment.

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 22 05 53 – Identification for Plumbing Piping and Equipment.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled equipment and their installation, including piping and electrical 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. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.6 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train the Owner's maintenance personnel to adjust, operate, and maintain all installed equipment. Refer to Section 01 79 00 – Demonstration and Training.

END OF SECTION 22 13 19

SECTION 22 33 00 - ELECTRIC DOMESTIC WATER HEATERS

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. Refer to Section 220 5 00 – Common Work Results for Plumbing.

1.2 SUMMARY

A. This Section includes the following electric water heaters:

1. Flow-control, instantaneous electric water heaters.
2. Light-commercial electric water heaters.
3. Compression tanks.
4. Water heater accessories.

1.3 SUBMITTALS

A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. LEED Submittal:

1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with ASHRAE/IESNA 90.1-2004, Section 7 - "Service Water Heating."

C. Shop Drawings: Diagram power, signal, and control wiring.

D. Product Certificates: For each type of commercial and instantaneous electric water heater, signed by product manufacturer.

E. Manufacturer Seismic Qualification Certification: Submit certification that commercial water heaters, accessories, and components will withstand seismic forces defined in Section 22 05 48 – Vibration and Seismic Controls for Plumbing Piping and Equipment. Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    a. 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."

b. 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."

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.

F. Source quality-control test reports.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For electric water heaters to include in emergency, operation, and maintenance manuals.

I. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain same type of electric water heaters through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of electric water heaters and are based on the specific system indicated. Refer to Section 01 60 00 – Product Requirements.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.

E. ASME Compliance: Where indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for all components that will be in contact with potable water.

1.5 COORDINATION

A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
    a. Structural failures including storage tank and supports.
    b. Faulty operation of controls.
    c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Period(s): From date of Substantial Completion:
    a. Instantaneous Electric Water Heaters: One year(s).
    b. Light-Commercial Electric Water Heaters:
        1) Storage Tank: Three years.
        2) Controls and Other Components: Two years.
    c. Compression Tanks: One year(s).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 LIGHT-COMMERCIAL ELECTRIC WATER HEATERS

A. Description: Comply with UL 174 for household, storage electric water heaters.

1. Manufacturers
    a. American Water Heater Company.
    b. Bradford White Corporation.
    c. Electric Heater Company (The); Hubbell Heaters Division.

d. GSW Water Heating Company.
e. Lochinvar Corporation.
f. Rheem Water Heater Div.; Rheem Manufacturing Company.
g. Ruud Water Heater Div.; Rheem Manufacturing Company.
h. Smith, A. O. Water Products Company.
i. State Industries, Inc.

2. Storage-Tank Construction: Steel, vertical arrangement.

a. Tappings: ASME B1.20.1 pipe thread.
b. Pressure Rating: 150 psig.
c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.

3. Factory-Installed Storage-Tank Appurtenances:

a. Anode Rod: Replaceable magnesium.
b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
c. Drain Valve: ASSE 1005.
d. Insulation: Comply with ASHRAE/IESNA 90.1-2004.
e. Jacket: Steel with enameled finish.
f. Heat Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
g. Heating Elements: Two; electric, screw-in immersion type; wired for simultaneous operation, unless otherwise indicated.
h. Temperature Control: Adjustable thermostat for each element.
i. Safety Control: High-temperature-limit cutoff device or system.
j. Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3 for combination temperature and pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.

4. Special Requirements: NSF 5 construction with legs for off-floor installation.

5. Capacity and Characteristics

a. Capacity: Refer to water heater schedule
b. Recovery: Refer to water heater schedule for temperature rise.
c. Temperature Setting: 125 deg F.
d. Electrical Characteristics:

1) Power Demand: Refer to water heater schedule
2) Volts: Refer to water heater schedule.
3) Phases: Refer to water heater schedule.
4) Hertz: 60.

2.3 COMPRESSION TANKS

A. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.

1. Manufacturers

   a. AMTROL Inc.
   b. Honeywell Sparco
   c. Myers, F. E.; Pentair Pump Group
   d. Smith, A. O.; Aqua-Air Div.
   e. State Industries, Inc.

2. Construction

   a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
   b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
   c. Air-Charging Valve: Factory installed.

3. Capacity and Characteristics

   a. Working-Pressure Rating: 150 psig.
   b. Capacity Acceptable: Refer to water heater schedule minimum.

2.4 WATER HEATER ACCESSORIES

A. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

B. Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include pressure setting less than water heater working-pressure rating.

C. Water Heater Stand and Drain-Pan Units: High-density-polyethylene-plastic, 18-inch- high, enclosed-base stand complying with IAPMO PS 103 and IAS No. 2. Include integral or separate drain pan with raised edge and NPS 1 drain outlet with ASME B1.20.1 pipe thread.

D. Water Heater Stands: Water heater manufacturer's factory-fabricated steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches above the floor.

E. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.

F. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4.

G. Piping Manifold Kits: Water heater manufacturer's factory-fabricated inlet and outlet piping arrangement for multiple-unit installation. Include piping and valves for field assembly that are capable of isolating each water heater and of providing balanced flow through each water heater.

H. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1-2004.

I. Water Regulators: ASSE 1003, water-pressure reducing valve. Set at 25 psig maximum outlet pressure, unless otherwise indicated.

J. Shock Absorbers: ASSE 1010 or PDI WH 201, Size A water hammer arrester.

2.5 SOURCE QUALITY CONTROL

A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial water heater storage tanks before shipment to minimum of one and one-half times pressure rating.

C. Prepare test reports.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

A. Install commercial water heaters on concrete bases.

1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
2. Concrete base construction requirements are specified in Section 22 05 00 – Common Work Results for Plumbing.

B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Install seismic restraints for light-commercial water heaters. Anchor to substrate.

D. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install combination temperature and pressure relief valves in water piping for water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

F. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Section 22 11 19 – Domestic Water Piping Specialties for hose-end drain valves.

G. Install thermometer on outlet piping of water heaters. Refer to Section 22 05 19 – Meters and Gages for Plumbing Piping for thermometers.

H. Install thermometers on inlet and outlet piping of household, collector-to-tank, solar-electric water heaters. Refer to Section 22 05 19 – Meters and Gages for Plumbing Piping for thermometers.

I. Install pressure gage(s) on outlet of commercial electric water- heater piping. Refer to Section 22 05 19 – Meters and Gages for Plumbing Piping for pressure gages.

J. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve, thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Section 22 05 23 – General Duty Valves for Plumbing Piping for general-duty valves and to Section 22 05 19 – Meters and Gages for Plumbing Piping for thermometers.

K. Install water regulator, with integral bypass relief valve, in booster-heater inlet piping and water hammer arrester in booster-heater outlet piping.

L. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.

M. Fill water heaters with water.

N. Charge compression tanks with air.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.

C. Ground equipment according to Section 26 05 26 – Grounding and Bonding for Electrical Systems.

D. Connect wiring according to Section 26 05 19 – Low Voltage Electrical Power Conductors and Cables.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial and instantaneous electric water heaters. Refer to Section 01 79 00 – Demonstration and Training.

END OF SECTION 22 33 00

SECTION 22 40 00 - PLUMBING FIXTURES
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. Refer to Section 22 05 00 – Common Work Results for Plumbing.

1.2 SUMMARY

A. This Section includes the following conventional plumbing fixtures and related components:

1. Faucets for lavatories, bathtubs, bathtub / showers, showers and sinks.
2. Laminar-flow faucet-spout outlets.
3. Flushometers.
4. Toilet seats.
5. Protective shielding guards.
6. Fixture supports.
7. Dishwasher air-gap fittings.
8. Disposers.
9. Hot-water dispensers.
10. Water closets.
11. Urinals.
12. Lavatories.
13. Commercial sinks.
14. Whirlpool bathtubs.
15. Service sinks.
16. Mop Sinks

B. Related Sections include the following:

1. Section 10 28 00 – Toilet, Bath, and Laundry Accessories.
2. Section 22 11 13 – Facility Water Distribution Piping for exterior plumbing fixtures and hydrants.
3. Section 22 11 19 – Domestic Water Piping Specialties for backflow preventers, floor drains, and specialty fixtures not included in this Section.
4. Section 22 32 00 – Domestic Water Filtration Equipment for water filters.
5. Section 22 43 00 – Medical Plumbing Fixtures.
6. Section 22 45 00 – Emergency Plumbing Fixtures.
7. Section 22 47 00 – Drinking Fountains and Water Coolers.
8. Section 22 46 00 – Security Plumbing Fixtures.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

F. FRP: Fiberglass-reinforced plastic.

G. PMMA: Polymethyl methacrylate (acrylic) plastic.

H. PVC: Polyvinyl chloride plastic.

I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. LEED Submittal: Product Data for Credit WE 2, 3.1, and 3.2: Documentation indicating flow and water consumption requirements.

C. Shop Drawings: Diagram power, signal, and control wiring.

D. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

E. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations

1. Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
2. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
2. Plastic Lavatories: ANSI Z124.3.
3. Plastic Mop-Service Basins: ANSI Z124.6.
4. Plastic Sinks: ANSI Z124.6.
5. Plastic Urinal Fixtures: ANSI Z124.9.
6. Plastic Whirlpool Bathtubs: ANSI Z124.1 and ASME A112.19.7M.
7. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
8. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
9. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
10. Vitreous-China Fixtures: ASME A112.19.2M.
11. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
12. Water-Closet, Flushometer Tank Trim: ASSE 1037.
13. Whirlpool Bathtub Fittings: ASME A112.19.8M.

H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.

4. Faucets: ASME A112.18.1.
5. Hose-Connection Vacuum Breakers: ASSE 1011.
6. NSF Potable-Water Materials: NSF 61.
7. Pipe Threads: ASME B1.20.1.
8. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
9. Supply Fittings: ASME A112.18.1.
10. Brass Waste Fittings: ASME A112.18.2.

I. Comply with the following applicable standards and other requirements specified for bathtub bathtub/shower and shower faucets:

1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
3. Deck-Mounted Bath/Shower Transfer Valves: ASME 18.7.
4. Faucets: ASME A112.18.1.
5. Hand-Held Showers: ASSE 1014.
6. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
7. Hose-Coupling Threads: ASME B1.20.7.
8. Manual-Control Antiscald Faucets: ASTM F 444.
9. Pipe Threads: ASME B1.20.1.
10. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
11. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
12. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.

J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Dishwasher Air-Gap Fittings: ASSE 1021.
4. Manual-Operation Flushometers: ASSE 1037.
5. Plastic Tubular Fittings: ASTM F 409.
6. Brass Waste Fittings: ASME A112.18.2.
7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

K. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Disposers: ASSE 1008 and UL 430.
2. Dishwasher Air-Gap Fittings: ASSE 1021.
3. Flexible Water Connectors: ASME A112.18.6.
4. Floor Drains: ASME A112.6.3.
5. Hose-Coupling Threads: ASME B1.20.7.
6. Hot-Water Dispensers: ASSE 1023 and UL 499.

7. Off-Floor Fixture Supports: ASME A112.6.1M.
8. Pipe Threads: ASME B1.20.1.
9. Plastic Toilet Seats: ANSI Z124.5.
10. Supply and Drain Protective Shielding Guards: ICC A117.1.
11. Whirlpool Bathtub Equipment: UL 1795.

1.6 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
    a. Structural failures of unit shell.
    b. Faulty operation of controls, blowers, pumps, heaters, and timers.
    c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Period for Commercial Applications: One year(s) from date of Substantial Completion.
3. Warranty Period for Residential Applications: Five years from date of Substantial Completion.

1.7 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. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 12 of each type.
4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
5. Water-Closet Tank, Repair Kits: Equal to 5 percent of amount of each type installed.
6. Toilet Seats: Equal to 5 percent of amount of each type installed.
7. Dry Urinal Trap-Seal Cartridges: Equal to 200 percent of amount of each type installed, but no fewer than 12 of each type.

PART 2 - PRODUCTS

2.1 DISHWASHER AIR-GAP FITTINGS

A. Dishwasher Air-Gap Fittings

1. Manufacturers: Subject to compliance with requirements, provide Watts Brass & Tubular or equal product by one of the following:

a. B & K Industries, Inc.
b. Brass Craft Mfg. Co.; a Subsidiary of Masco Corporation
c. Brasstech Inc.; Newport Brass Div.
d. Dearborn Brass; a div. of Moen, Inc.
e. Geberit Manufacturing, Inc.
f. JB Products; a Federal Process Corporation Company
g. Sioux Chief Manufacturing Company, Inc.

2. Description: Fitting suitable for use with domestic dishwashers and for deck mounting; with plastic body, chrome-plated brass cover; and capacity of at least 5 gpm; and inlet pressure of at least 5 psig at a temperature of at least 140 deg F. Include 5/8-inch- ID inlet and 7/8-inch- ID outlet hose connections.

3. Hoses: Rubber and suitable for temperature of at least 140 degrees F.

a. Inlet Hose: 5/8-inch ID and 48 inches long.
b. Outlet Hose: 7/8-inch ID and 48 inches long.

2.2 COMMERCIAL SINKS

A. Commercial Sinks, Refer to plumbing fixture schedule for fixture type:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Description: counter-mounting, stainless-steel, commercial, sink fixture.

a. Type: Basin with radius corners, back for faucet, and support brackets.
b. Faucet: Back-mounting, chrome-plated, solid-brass, gooseneck type with individual valves.
c. Supplies: NPS 1/2 chrome-plated copper with stops.
d. Drain: Grid.
e. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; 0.045-inch- thick tubular brass waste to wall; and wall escutcheon.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.

G. Install counter-mounting fixtures in and attached to casework.

H. Install fixtures level and plumb according to roughing-in drawings.

I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Section 22 05 23 – General Duty Valves for Plumbing Piping.

J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

K. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

L. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

M. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

N. Install shower flow-control fittings with specified maximum flow rates in shower arms.

O. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

P. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install in sink deck. Connect inlet hose to dishwasher and outlet hose to disposer.

Q. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Section 22 05 00 – Common Work Results for Plumbing.

R. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Section 07 92 00 – Joint Sealants.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Section 26 05 26 – Grounding and Bonding for Electrical Systems.

D. Connect wiring according to Section 26 05 19 – Low Voltage Electrical Power Conductors and Cables.

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust disposers hot-water dispensers and controls. Replace damaged and malfunctioning units and controls.

C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

D. Replace washers and seals of leaking and dripping faucets and stops.

E. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 40 00

SECTION 230000 - GENERAL HVAC REQIREMENTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. It is intended for the Division 23 scope of work to include complete and functional mechanical systems - including all required materials, labor, equipment, and services necessary to achieve the desired final product. It is further intended for the Division 23 scope of work to include coordination with Divisions 21 and 22 and all work required by Division 23 for complete Fire Protection and Plumbing systems.

1.2 REVISION TO DIVISION NUMBERING

A. These documents have been revised to reflect new numbering standards. All Mechanical documents were previously contained within Division 15. These documents have now been divided into Fire Protection, Plumbing and HVAC and renumbered as Divisions 21, 22 and 23, respectively.

1.3 COORDINATION OF DIVISIONS 21, 22 AND 23.

A. Divisions 21, 22 and 23 are used to communicate the requirements for the total Mechanical scope of work. It is intended for these three Divisions to serve as a single document, communicating the Mechanical scope of work.

1.4 REFERENCES

A. Division 00 and Division 01 of these specifications shall govern Division 23 work, including Bidding Requirements, Conditions of the Contract, and Supplementary Conditions. It is the Division 23 Contractor's responsibility to be aware of all information and requirements included in these locations, and to include those requirements as part of the Division 23 scope of work.

B. It shall be understood by the Division 23 Contractor that the Division 23 scope of work is intended to involve a coordinated effort with all other Divisions of work. Refer to other sections of the documents for additional related requirements and to ensure a coordinated effort.

C. References to industry standards, testing procedures, etc. are noted in individual sections of these specifications. The requirements and standards from the referenced documents shall be considered part of the requirements of these specifications.

D. This section applies to all Division 23 work. The Division 23 Contractor shall ensure that all Division 23 work described throughout other specification sections and on the drawings is in accordance with this section.

E. It shall be understood by the Contractor that the Division 21, 22 and 23 information is intended to serve as a single document, and each section of these specifications directly or indirectly relates to all other sections. As such, each section does not attempt to identify every other

Division 21, 22 and/or 23 section that is related. Significant references to information outside of Division 21, 22 and 23 are, however, occasionally provided for informational purposes. This information is provided to assist in coordination, but the lack of a reference to another portion of the Contract Documents does not relieve the Contractor of the responsibility for coordination with other sections of Divisions 21, 22 and 23 and all other trades.

1.5 DEFINITIONS

A. The following definitions shall apply to the use of these words when used in Division 23. These definitions are not intended to define use of these words outside of Division 23.

B. Acceptance: The Owner's assumption of ownership of the mechanical system.

C. 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.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Contractor (The Contractor, This Contractor, Division 23 Contractor, etc.): The contractor responsible for the Division 23 scope of work.

F. Date of Acceptance: The official date when Acceptance occurs. This will coincide with the granting of Substantial Completion unless noted otherwise by the Owner's Representative. It shall not be assumed that the Date of Acceptance has deviated from Substantial Completion unless written documentation is provided by the Owner's Representative indicating differently.

G. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

H. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

I. 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.

J. Mechanical: Shall be considered interchangeable with "Division 23".

K. Owner's Representative: The Architect or his designated representative, as outlined in the General Conditions.

L. Provide: Furnish and install.

1.6 ABBREVIATIONS

A. The following are industry abbreviations used in these specifications: ABS: Acrylonitrile-butadiene-styrene plastic; ASJ: All-service jacket; BR: Butyl rubber; Buna-N: Nitrile rubber; CPVC: Chlorinated polyvinyl chloride plastic; CR: Chlorosulfonated polyethylene synthetic rubber; CSM: Chlorosulfonyl-polyethylene rubber; CWP: Cold working pressure; DDC: Direct digital control; DOP: Dioctyl phthalate or bis-(2-ethylhexyl) phthalate; EMCS: Energy Management and Control System; EPDM: Ethylene-propylene-diene terpolymer rubber; FOG: Fats, oils, and greases; FRP: Fiberglass-reinforced plastic; FSK: Foil, scrim, kraft paper; FSP: Foil, scrim, polyethylene; HDPE: High-density polyethylene plastic; HEPA: High-efficiency particulate air; I/O: Input/output; LLDPE: Linear, low-density polyethylene plastic; MS/TP: Master slave/token passing; MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc; NBR: Acrylonitrile-butadiene rubber; NC: Noise criteria; NR: Natural rubber; NUSIG: National Uniform Seismic Installation Guidelines; PE: Polyethylene plastic; PEX: Crosslinked polyethylene plastic; PC: Personal computer; PID: Proportional plus integral plus derivative; PMMA: Polymethyl methacrylate (acrylic) plastic; PP: Polypropylene plastic; PTFE: Polytetrafluoroethylene plastic; PUR: Polyurethane plastic; PVC: Polyvinyl chloride plastic; PVDC: Polyvinylidene chloride; RC: Room criteria; RTD: Resistance temperature detector; SSL: Self-sealing lap; SWP: Steam working pressure; TFE: Tetrafluoroethylene plastic; TPE: Thermoplastic elastomer; ULPA: Ultra low penetration air.

1.7 APPLICABLE CODES

A. Division 23 work shall be performed in accordance with applicable codes and standards as adopted by the authorities having jurisdiction including amendments. Following is a listing of major codes and standards, the requirements of which shall be considered part of the scope of this project. This list should not be considered comprehensive, and codes or standards not included in this list should not be considered to be excluded from the scope of the project.

1. Americans with Disabilities Act ADA)
2. Applicable State and Local Codes and Ordinances
3. National Electrical Code
4. International Building Code
5. International Fire Code
6. International Mechanical Code
7. Uniform Plumbing Code

1.8 PERMITS AND FEES

A. All permits and inspections required to complete the Division 23 scope of work shall be included in the Division 23 bid price. All certifications provided as part of the permit and inspection process shall be provided to the Owner as part of the Division 23 scope of work as specified in these documents.

B. All fees required by utility providers shall be included in the Division 23 bid price, including water, gas, sanitary sewer, and storm sewer connections. This shall include all charges to the

project by these agencies, including but not limited to general fees, equipment charges (meters, vaults, etc.), tap fees, and utility main installation charges.

1.9 ALTERNATES (REFER TO DIVISION 01)

A. The bid price for the scope of work shall be separated into base bid and alternate values when indicated. Both base bid and alternate bid prices shall reflect a complete and working mechanical system, with specific features and/or portions of the systems designated as base bid or alternate as described.

1.10 SCOPE AND APPROPRIATE USE OF BID DOCUMENTS

A. These specifications and accompanying drawings are intended to communicate the design concept for this project and outline the scope of work. They should not be viewed as a comprehensive document that details every specific task, item, or piece of equipment required to complete the project. It is understood that industry knowledge and experience is required to establish an accurate and complete scope of work from these documents, and it is assumed that the Division 23 Contractor possesses that knowledge and experience. Work not specifically noted in these specifications or the accompanying drawings, but which is required to complete the project, shall be included by the Division 23 Contractor as part of his scope of work.

B. These specifications and the accompanying drawings are intended to supplement each other. Information included in either one shall be incorporated into the project as if included in both. In the event of any conflicts, the most stringent requirements shall be considered the governing scope of work until and unless clarification can be obtained by the Contractor.

C. In the event of dimensional discrepancies between Division 23 documents and other disciplines, Architectural and Structural documents take precedence over Division 23. Refer to this information for sufficient understanding to the extent that it impacts the Division 23 scope of work.

D. Drawings are intended to indicate the general arrangement of piping, ductwork, equipment and other components of Division 23 systems. They shall be followed as closely as possible, but shall be considered diagrammatic in nature. They are not intended to show every component, fitting, offset, etc. Components, fittings, offsets, etc. as required to meet the intent of the documents and to achieve coordination with other trades shall be included in the Division 23 scope of work. Note that more detailed information about routing may be provided for certain areas of the project where special constraints exist. It is the intent of this detailed information to better communicate the constraints, but these drawings and details shall still be considered diagrammatic in nature as outlined above.

1.11 ROUTING AND LOCATIONS

A. It is the Contractor’s responsibility to coordinate equipment locations and system routing with available space and with all other trades.

B. It is the Contractor’s responsibility to coordinate and verify the exact locations and routing of equipment and systems prior to fabrication and installation. If discrepancies become apparent

as part of the verification process, the Contractor shall ask for written clarification/direction. Alteration, removal and/or replacement of work already installed as a result of failure to verify and/or coordinate locations and routing prior to fabrication and/or installation shall be at the Contractor's expense.

C. Locations of equipment shown on the drawings are approximate unless specifically dimensioned.

D. All ductwork, piping, tubing, conduit, etc. shall be concealed within building construction unless noted otherwise. Mechanical rooms are considered to be within building construction for the purposes of this requirement.

E. Existing utilities, piping, and ductwork have been indicated as closely as possible. The Contractor can assume that points of connection to existing utilities have been shown within 10 feet (3 meters) of the actual location. When actual points of connection are more than 10 feet (3 meters) from the location shown on the drawings, the Contractor shall notify the Owner's Representative prior to commencing this portion of the work.

F. The Contractor is responsible for any remedial work required from failure to locate and preserve underground utilities. This shall include all work necessary to repair any damaged utilities to their original condition.

1.12 SCHEDULING

A. It is understood that while drawings are to be followed as closely as circumstances permit, the Contractor shall be responsible for installation of systems according to the true intent and meaning of Contract Documents. Anything not clear or in conflict will be explained by making application to Owner's Representative. The Contractor shall familiarize himself with his scope of work as well as the required coordination with other trades and the scheduling of other trades sufficiently to address coordination issues in a timely manner such that they do not result in remedial work for other trades.

B. Should conditions arise where certain changes would be advisable, secure approval from Owner's Representative for those changes before proceeding with work. Proceeding without written approval is at the Contractor's risk and at the Contractor's expense.

C. The contractor shall coordinate with the work of various trades when installing interrelated work. Before installation of mechanical items, proper provisions shall be made to avoid interferences. Changes required in work specified in Division 23 caused by neglect to do so shall be made at no cost to Owner.

D. Inserts and supports required by Division 23 shall be furnished and installed unless otherwise noted. Furnish sleeves, inserts, supports, and equipment that are an integral part of other Divisions of the Work to those involved in sufficient time to be built into construction as the Work proceeds. Locate these items and see that they are properly installed. Expense resulting from improper location or installation of items above shall be borne under Division 23.

1.13 CUTTING AND PATCHING

A. The Division 23 Contractor shall be responsible for all cutting and patching required to complete the Division 23 scope of work.

B. All patching shall be performed such that it matches existing finishes.

C. The Contractor shall not cut any structural members without first getting approval from the Owner's Representative to do so.

D. All cutting and patching required to correct defective or otherwise unacceptable work shall be the responsibility of the Division 23 Contractor.

1.14 GUARANTEE (REFER TO DIVISION 01)

A. All Division 23 systems and equipment shall be guaranteed for a minimum period of one year.

B. Specific equipment and/or systems requiring warranties beyond one year are indicated in the table at the end of this section.

C. The guarantee shall begin at the Date of Acceptance, unless written documentation is provided noting otherwise. When more than one Date of Acceptance is indicated for various portions or specific equipment, the guarantee shall begin at the Date of Acceptance independently for each portion of the system or piece of equipment.

D. Permission to use Division 23 systems or equipment for temporary heating or other contractor use prior to the Date of Acceptance, as outlined elsewhere in these specifications, shall not constitute the beginning of the guarantee period. The contractor shall make any necessary arrangements to extend equipment and/or system warranties sufficient to maintain the designated guarantee period from the Date of Acceptance.

1. Exception: When temporary heating and or other system use is requested by the Owner for the Owner's benefit prior to the Date of Acceptance, the guarantee period for the portions of the system or specific equipment requested for use may begin at the time it is put into service. This can only be assumed to have occurred if written documentation is provided indicating such.

1.15 QUALITY ASSURANCE

A. Material and Equipment Qualifications

1. Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

2. Alternative Qualifications: Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

B. Service Support: The equipment items shall be supported by service organizations. When requested to gain approval, submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

C. Manufacturer's Nameplate: Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

D. UL Listings: All equipment shall be provided with a UL or approved equivalent label when labeling is available for that type of equipment.

E. Fuel-fired equipment shall be labeled by the appropriate nationally recognized label for the fuel type (i.e. AGA).

F. All control panels shall be UL listed (or equivalent approved label).

G. Pressure vessels shall be provided in accordance with applicable pressure vessel ordinances.

H. All mechancial equipment shall have an AIC rating of 100,000 or otherwise specified on electrical one-line diagrams fault current for each piece of equipment.

1.16 SUBSTITUTIONS (REFER TO DIVISION 01)

A. When multiple manufacturers are listed in these specifications, equipment can be used from those manufacturers providing they can meet the requirements of the specifications and drawings. This shall include meeting capacity requirements, efficiencies, space and weight limitations, electrical provisions, etc. The detailed information in the specifications, scheduled equipment information, additional drawing information and any specific references to a particular manufacturer and/or model of equipment shall be considered the basis of design. Other listed manufacturers, even when listed in these specifications, will only be allowed if they meet or exceed that basis of design.

B. Substitutions involving manufacturers not listed in these specifications will not be allowed without written approval. When written approval is requested, information will be reviewed in preliminary fashion for general conformance only. Any approved manufacturers will still be required to meet the requirements of these specifications and the drawings, and final approval during submittal review will only be granted if the equipment meets or exceeds the requirements of the documents.

C. It is the Contractor’s responsibility when utilizing approved substituted equipment to ensure the equipment will fit within the constraints of the project as detailed using the basis of design equipment (space, weight, power, etc.). Any required alterations by Division 23 or any other Division of work to accommodate differences between the substituted equipment and the basis of design equipment shall be the responsibility of the Division 23 Contractor, including the cost of design for the required changes.

D. If the changes required by substituted equipment cannot be accommodated, the Contractor shall be responsible for replacing the substituted equipment with the basis of design equipment.

E. Proposed substituted equipment will not be considered equal if it requires an increase of more than 5% in power usage at design conditions.

1.17 MECHANICAL COST BREAKDOWN (REFER TO DIVISION 01)

A. Provide a breakdown of construction costs within 30 days of Notice to Proceed, with separate costs for each of the items listed in the table at the end of this section.

1.18 PAYMENT REQUESTS

A. Submittals and operation and maintenance data must be received and approved before payment requests will be considered for materials and equipment.

B. EMCS submittals must be received before payment requests will be reviewed for this portion of the work. Only payment requests for programming and submittals will be reviewed until submittals are approved.

C. Fire sprinkler system submittals, including code-approved shop drawings, must be received before payment requests will be reviewed for this portion of the work. Only payment requests for design and submittals will be reviewed until submittals are approved.

1.19 TEMPORARY HEATING (REFER TO DIVISION 01)

A. Temporary heating shall not be provided by the permanent mechanical system.

1. Exception: The Owner's Representative may choose to allow the Contractor to use the permanent mechanical system. In such cases, the Contractor shall obtain written authorization from the Owner's Representative. In no case shall the permanent system be used until and unless this written authorization is granted.

B. If allowed to use the permanent systems for temporary heating, the following constraints shall apply:

1. The contractor shall be responsible for providing a clean system at substantial completion, to include pressure cleaning of coils and vacuum cleaning of ductwork if required to negate the effects of use during construction.

2. Granting the use of equipment and systems for temporary heat will not constitute Acceptance of equipment, and will not start the warranty or guarantee period for the Owner.

3. System guarantee and equipment warranties shall be extended to maintain the guarantee and warranty periods from the Date of Acceptance. Any costs associated with extension of warranties shall be at the Contractor's expense.

4. Filters shall be installed meeting the requirements of these documents. When multiple stages of filtration are provided on a system, filters meeting the requirements of the first stage of filtration shall be provided and maintained during use. A minimum of MERV 13

filtration filters shall be used during this time, even if this requirement is more stringent than the requirements for permanent filtration. New filters shall be provided prior to system balancing.

5. Filter fabric shall be provided at all return grilles, and shall be replaced as appropriate to maintain a clean system.

1.20 SUBMITTALS (REFER TO DIVISION 01)

A. Submittal information shall be provided and approved on all materials and equipment prior to ordering.

B. Provide indication of which options and accessories are to be included.

C. Include all scheduled information for equipment listed in schedules on the drawings.

D. Review will be for general conformance only, and shall not relieve the Contractor for any deviations from the requirements of the documents unless clear written reference is made by the Contractor in the submittal to proposed deviations.

E. All Division 23 information shall be provided in one complete submittal, indexed by specification section.

1. Exceptions: Fire protection and EMCS submittals can be provided separately. At the discretion of the Owner's Representative, partial submittals may be provided. If allowed, provide a table indicating submittal status with each submittal, and provide an initial submittal with all required tabs and space for all current and future submittals.

F. Provide operation and maintenance data for individual equipment after initial submittals have been reviewed.

G. Efficiency Standards

1. Units requiring more than a 5% increase in power input beyond the scheduled equipment to meet design capacities will not be considered equal.

2. Units requiring more than a 15% increase in fan brake horsepower over the scheduled equipment to meet the design flow and external static pressure requirements will not be considered equal and will not be accepted.

1.21 DELIVERY, STORAGE, AND HANDLING

A. Follow manufacturer's directions in delivery, storage, protection, and installation of equipment and materials.

B. Promptly notify Owner's Representative in writing of conflicts between requirements of Contract Documents and Manufacturer's directions and obtain written instructions from Owner's Representative before proceeding with work. The Contractor shall bear expenses arising from correcting deficiencies of work that do not comply with manufacturer's directions or such written instructions from Owner's Representative.

C. Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

D. Store ductwork in a clean, dry location. If the location of storage cannot be protected from moisture, keep ductwork above grade level to protect from standing water.

1.22 OPERATION AND MAINTENANCE MANUALS

A. Operation and Maintenance Manuals shall be provided in three post binders capable of having materials added or removed. Standard clasp-type binders are not acceptable. Binders with overlapping, telescoping posts shall be used.

B. Provide a title page at the beginning of the manual with the project title, date, Architect, Engineer, and Contractor. Also provide a master index. The title page and index shall be provided at the beginning of each volume when multiple volumes are required.

C. Organize the manual into five divisions: Contacts, Equipment, Maintenance Schedule and Extra Materials, Energy Management and Controls System, Warranties and Certifications.

1. Contacts division: Division shall consist of name, address, and phone number of the following parties: Architect, Mechanical Engineer, Electrical Engineer, General Contractor, Mechanical Contractor, Plumbing Contractor, Sheet Metal Contractor, EMCS Contractor, Electrical Contractor and major equipment suppliers.

2. Equipment division: Provide a separate section for each section of the specifications. Each section shall include, at a minimum, the following for each item of Division 23 equipment.

   a. Performance curves or tables showing the specified operating points and the operating points after final testing and balancing

   b. Manufacturer’s maintenance instructions: Instructions shall include name of vendor, installation instructions, parts numbers and lists, operating instructions for equipment, maintenance and lubrication instructions, troubleshooting guides, and overhaul specifications for major equipment.

   c. Wiring diagrams

   d. Step-by-step procedures for putting each piece of mechanical equipment into operation

   e. Refer to individual specification sections for additional information required to be incorporated into the Operation and Maintenance Manual.

3. Maintenance Summary and Extra Materials division: Division shall include two sections.

   a. The first section shall consist of a preventative maintenance schedule summary table (or list). The table shall be organized by specification section and include equipment name and designation as it appears on the equipment schedule, equipment location, and type and frequency of preventative maintenance requirements (including lubrication).

b. The second section shall consist of a list of extra materials furnished under this contract. The list shall be organized by specification section and include equipment name and designation as it appears on the equipment schedule, extra material(s) furnished, and verification by an owner's representative that material(s) have been provided. List shall be similar to that included at the end of this section.

4. Energy Management and Controls System division: Division shall be as specified in 230900.

5. Warranties and Certificates division: Division shall include

   a. Test and balance reports

   b. Test records of piping, tanks, ductwork, etc

   c. Signed checklist of Instruction Period

   d. Certificate from Health Department indicating acceptance of domestic water quality

   e. Copies of specific product Warranties

   f. Copies of certified factory start-up reports

   g. Valve tag identification schedules

   h. Fire sprinkler system certification

D. Prior to binding, submit one copy of Operation and Maintenance Manual to Owner's Representative for review. After this review and final approval of the manuals, prepare two (2) copies of approved manuals for use during the instruction period. Following instruction period, turn over both copies to the Owner.

E. Manuals may be compiled in multiple volumes if necessary for ease of use.

1.23 OPERATION AND MAINTENANCE TRAINING

A. General

1. Provide two training sessions for the Owner. The first training session shall occur prior to substantial completion. The second training session shall occur prior to completion of the warranty period. The content below is required for the first training session. The content for the second training session shall be as requested by the Owner, up to an including all information included in the first training session.

2. Operation and maintenance of mechanical systems utilizing Operation and Maintenance Manual. During the training session, each piece of equipment shall be located, and all information included in the O&M manuals shall be demonstrated to the satisfaction of the Owner's Representative.

3. Individuals present shall include the mechanical contractors, subcontractors and equipment factory representatives as appropriate. Certified factory representatives shall be present for all equipment requiring certified factory start-up.

4. Provide a video tape of the training sessions conducted and furnish copies of the tape to the Owner. Video tapes shall be of sufficient quality to allow training of future employees or refresher training of personnel. Turn over to the Owner in DVD format.

5. The two training sessions shall each occur in one consolidated session for all mechanical equipment.

    a. Exceptions:

        1) Training for equipment requiring certified factory start-up shall be conducted at the time of start-up.
        2) Multiple sessions shall be scheduled as required to maintain a maximum allowable duration of any single session of four hours.
        3) When separate training sessions are warranted to achieve proper training on all equipment and systems, as determined by the owner's representative, multiple sessions shall be scheduled as required.
        4) EMCS system training shall occur independently, and shall be in accordance with the requirements of Section 230900.
        5) Training session shall include all equipment included in the table at the end of this section. A table similar to this one shall be used to verify owner training has been completed on all equipment, and shall be included in the Operation and Maintenance Manual.

6. Extra Materials

    a. A list of extra materials to be provided under this contract has been included at the end of this section. Refer to individual specification sections for specific requirements of extra materials to be furnished under this contract.

    b. Turn extra materials over to Owner.

        1) Provide summarized list of extra materials that have been furnished. List shall include verification by Owner's Representative that parts have been furnished. Incorporate into O&M Manual. Extra materials list shall be similar to that provided at the end of this section.

7. Cleaning

    a. Leave all equipment and systems in a clean and new condition at the completion of the project. Clean all piping and ductwork exposed in finished spaces. Remove all stickers from equipment in finished spaces (plumbing fixtures, etc.). Repair all scratched and damaged equipment to new condition, to include touch-up painting.

8. Record Drawings

    a. Maintain a set of Contract Documents dedicated for record drawings. These documents shall incorporate all clarifications and changes provided by the Owner's Representative, as well as field changes made by the Contractor. All markings shall be neat and legible. Turn over documents to the Owner's Representative at the completion of the project.

9. Punch Lists

a. Notify the Owner's Representative in writing when the project is ready for punch lists.

b. When all punch list items have been addressed, notify the Owner's Representative in writing that the project is ready for a backcheck of completed punch list items. Include a copy of the original punch list with each completed item initialed and any required notation indicating if something was not completed and why.

c. If, at the time of the backcheck, items are found that continue to be in nonconformance with the project documents, these items will be forwarded to the Contractor. Completion of these items shall be required to achieve substantial completion. All site visits required beyond the initial punch list and initial back check visits, including visits required to verify completion of these remaining outstanding items, shall be charged to the Contractor at normal billing rates.

10. Visiting the Project Site

a. The premises shall be examined and conditions shall be understood which may affect performance of work of this Division before submitting proposals for this work.

b. No subsequent allowance for time or money will be considered for any consequence related to failure to examine existing site conditions.

B. Products (Not Used)

C. Execution (Not Used)

D. Tables

1. Cost Breakdown Table

Cost Breakdown Table		
Category	**Material Cost**	**Labor / Installation Cost**
Mobilization		
Supervision		
Site Utilities		
HVAC Piping Insulation		
Duct External Insulation		
Air and Water Balance		
EMCS Programming and Submittals		
EMCS Installation		
Hydronic Piping Systems		
Hydronic Pumps		
Steam and Condensate Piping Systems		
Steam Condensate Pumps		
Refrigerant Piping Systems		
HVAC Water Treatment		
Ductwork Fabrication		
Ductwork Installation		
Power Ventilators		
Air Terminal Units		
Grilles, Registers, and Diffusers		
Intake and Relief Ventilators		
Breechings, Chimneys, and Stacks		
Boilers		
Heat Exchangers		
Condensing Units		
Water Chillers		
Cooling Towers		
Air Handling Units		
Terminal Heat Transfer Units		
Fan Coil Units		
Commissioning Assistance		

2. Submittal Table

Submittal Table				
	Submittal Data Included	**Submittal Previously Approved**	**O&M Data Included**	**O&M Previously Approved**
230500 – Basic HVAC Materials and Methods				
Access Doors				
Dielectric Fittings				
Escutcheons				
Mechanical Sleeve Seals				
Welding Certificates				
230529 – HVAC Hangers and Supports				
Fastener Systems				
Metal Framing Systems				
Welding Certificates				
230553 – Mechanical Identification				
Access Panel and Door Markers				
Ceiling Tacks				
Nameplates				
Pipe Markers				
Tags				
Valve Schedules - A preliminary chart shall be submitted at submittal time, and shall be updated as part of the as-built documentation process.				
List of all equipment/items to receive nameplates indicating designation to be printed on nameplate.				
230593 – HVAC Testing, Adjusting, and Balancing				
Firm Qualifications and Certifications				
Construction Documents Examination Report				
Strategies and Procedures Plan				
Sample Report Forms				
Certified TAB Report				
230700 – HVAC Insulation				
Pipe Insulation – Cellular Foam				
Pipe Insulation – Glass Fiber				
Pipe Insulation – Cellular Glass				
Pipe Jacketing				
Duct Insulation - Glass Fiber, Flexible Blanket (Duct Wrap)				
Duct Insulation - Glass Fiber, Flexible (Duct Liner)				
Duct Insulation - Glass Fiber, Rigid				
Equipment Insulation – Glass Fiber				

Submittal Table				
	Submittal Data Included	**Submittal Previously Approved**	**O&M Data Included**	**O&M Previously Approved**
Schedule Including Piping Systems, Insulation Type, Insulation Thickness Relative To Pipe Size				
Schedule Including Equipment, Insulation Type, Insulation Thickness				
Schedule Including Duct Systems, Insulation Type, Insulation Thickness				
233100- Ductwork				
Table indicating sheet metal materials to be used for each system type.				
Low Velocity Ductwork and Fittings				
Medium Velocity Ductwork and Fittings				
Chemical Fume Hood Exhaust Ductwork				
Clothes Dryer Exhaust Ductwork				
Flexible Ducts				
Kitchen Exhaust Ductwork				
Sealants				
233300 – Duct Accessories				
Access Doors				
Backdraft Dampers				
Duct-Mounted Access Doors				
Duct Silencers				
Fire and Smoke Dampers				
Flexible Duct Connectors				
Flexible Ducts				
Turning Vanes				
Volume Balancing Dampers				
233710 – Grilles, Registers, and Diffusers				
Sidewall Supply Grilles (Double Deflection)				
Return Grilles				
Modular Core Ceiling Diffusers				

3. Operation and Maintenance Training Table

Operation and Maintenance Training Table	
System	**O&M Training Complete**
230900 – Energy Management and Control System	
232100 – Hydronic Piping Systems	
232120 – Hydronic Pumps	
232200 – Steam and Condensate Piping Systems	
232220 – Steam Condensate Pumps	
232300 – Refrigerant Piping Systems	
232500 – HVAC Water Treatment	
233400 – Power Ventilators	
233600 – Air Terminal Units	
234100 – Air Filters	
235200 – Boilers and Accessories	
235700 – Heat Exchangers	
236200 – Condensing Units	
236400 – Water Chillers	
236500 – Cooling Towers	
237400 – Air Handling Units	
237400 – Terminal Heat Transfer Units	
The Contractor, associated factory representatives and subcontractors, have started each system and the total system and have proved their normal operation to the Owner's representative and have instructed him in the operation and maintenance thereof. _____ _____ Owner's Representative Contractor	

4. Extra Materials List

Extra Materials List				
Specification Section	**Mechanical Equipment**	**Extra Materials**	**Verified By**	**Date**
230519	HVAC Meters and Guages	Test Kit		
232120	Hydronic Pumps	One (1) Set of Mechanical Seals for Each Pump		
233400	Power Ventilators	One (1) Set of Fan Belts for Each Fan		
237400	Air Handling Units	One (1) Set of Fan Belts for Each Different Size and/or Type of Belt		
237400	Air Handling Units	One (1) Fan Bearing For Each Different Size and/or Type of Bearing		
237400	Air Handling Units	One (1) Set of Filters for Each Air Handling Unit		
233300	Duct Accessories	Fusible Links Equal to 10% of the Amount Installed		
233400	Power Ventilators	One (1) Spare Set of Belts and Bearings for Each Belt Driven Unit		
234100	Air Filters	One (1) Complete Set of Filters for Each Filter Bank		
234100	Air Filters	One (1) Container of Red Oil for Inclined Manometer Filter Guage		

5. Extended Warranty List

Extended Warranty List		
Specification Section	**Mechanical Equipment**	**Warranty Description**
230900	Actuators	3 year unlimited warranty
232115	Ground Loop Piping	50 Year Limited Warranty
235200	Boilers	Heat Exchangers: 10 year warranty

6. Pre-Balance Checklist

Pre-Balance Checklist	
Item	**Complete**
General Contractor	
All doors and closures, windows and ceiling tile shall be installed	
96-hour run test complete	
Plumbing Contractor	
All valves, flow meters, temperature/pressure taps installed correctly, functional and accessible.	
Strainers and piping, clean, flushed, and free of debris	
Construction strainer baskets replaced with permanent baskets	
System filled to proper level and pressure reducing valve set	
Automatic and manual air vents properly installed and functional	
All air purged from system	
Water in expansion tanks at proper level	
All coils piped correctly and accessible	
Correct pump rotation	
Pumps properly aligned, grouted, and anchored	
Vibration isolators properly installed and adjusted	
Service and balance valves are open	
Sheet Metal Contractor	
Ductwork is intact and properly sealed	
Ductwork leak tested and repaired as required	
Access doors installed and properly secured	
Ductwork end caps installed	
Ductwork installed according to drawings and specifications	
Ductwork is free of debris	
All dampers, fire, volume, mixing, splitters are installed, accessible and open	
All terminal boxes, reheat coils, operators and dampers are installed, accessible and operable	
Return air has unobstructed path from each conditioned space back to the unit	
All grilles, registers, diffusers and other devices are installed and functional	
Filters are clean and correctly installed	
Filter frames correctly installed and sealed	
Coils clean, properly installed and sealed	
Drive components installed	
Sheaves properly aligned and tight on their shaft	
Belts adjusted for correct tension	
Belt guard properly installed	
Automatic control dampers installed and functional	
Fan rotation correct	
Fan housing installed and sealed	
All flex connections and vibration isolators are installed correctly	

Pre-Balance Checklist	
Item	**Complete**
Fan wheel aligned with adequate clearance	
Fan bearings lubricated	
Controls Contractor	
Controls complete and functional	
Thermostats and sensors calibrated	
Program correct and functional	
Electrical Contractor	
Motors wired and energized	
Proper starter and overload protection installed	
Correct fuses installed	
Motor secured to frame	
Motor bearings lubricated	
Fire alarms and duct smoke detectors are fully operational	
General Contractor Sign-Off: _____ Date: _____	
Plumbing Contractor Sign-Off: _____ Date: _____	
Sheet Metal Contractor Sign-Off: _____ Date: _____	
Controls Contractor Sign-Off: _____ Date: _____	
Electrical Contractor Sign-Off: _____ Date: _____	

END OF SECTION 23 00 00

SECTION 23 05 00 - BASIC HVAC MATERIALS AND METHODS

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.

B. Section 230000 – General HVAC Requirements

1.2 SUBMITTALS

A. General

1. Product data for specified materials.
2. Welding certificates

1.3 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 Mechanical 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.

1.4 DELIVERY, STORAGE, AND HANDLING

A. 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.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.5 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors shall be provided as required for Division 23 systems and equipment by Division 23 in accordance with Division 08.

PART 2 PRODUCTS

2.1 ACCESS DOORS

A. Access doors shall be provided by Division 23 when serving Division 23 systems and equipment in accordance with the requirements of Division 08.

2.2 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.

2.3 ESCUTCHEONS

A. Description: Chrome plated steel 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.

2.4 HOUSEKEEPING PADS

A. Housekeeping pads shall be provided by Division 23 when serving Division 23 systems and equipment and shall be made of concrete in accordance with the requirements of Division 03.

2.5 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below. Joining material requirements listed in individual Sections shall supersede the requirements in this section.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
    a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. 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.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.6 MECHANICAL SLEEVE SEALS

A. Manufacturers:

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

C. Construction: Sealing element - EPDM interlocking links shaped to fit surface of pipe, type and number required for pipe material and size of pipe; pressure plates - stainless steel, include two for each sealing element; connecting bolts and nuts - stainless steel of length required to secure pressure plates to sealing elements, include one for each sealing element.

2.7 PAINT

A. When painting is noted in Division 22 as required, paint shall be provided by Division 22 in accordance with the requirements of Division 09.

2.8 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gauge (1.2 mm) thick galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gauge (1.2 mm) thick galvanized steel.

C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed, refer to Section 07270.

D. Sleeves for below grade piping passing under footings: Class 52; ductile iron.

E. Sleeves for below grade piping passing through exterior walls - Mechanical Sleeve Seals.

F. Sleeves for Ductwork: Galvanized steel.

G. Miscellaneous

1. Stuffing Insulation: Glass fiber type; non-combustible; 3 lb. density.

2. Fire Safeing Sealant: Intumescent material capable of expanding up to 8 to 10 times when exposed to temperatures beginning at 250°F. It shall have ICBO, BOCA I approved ratings to 3 hours per ASTM E814 (UL 1479). 3M Fire Barrier Caulk, Putty, strip and sheet forms.

2.9 SUPPORTS AND ANCHORAGES

A. Metal supports for Division 23 systems and equipment shall be provided in accordance with the requirements of Division 05.

PART 3 EXECUTION

3.1 GENERAL

A. Mechanical Demolition

1. Refer to Division 1 and Section 220000 for general demolition requirements and procedures.

2. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated 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.

c. Ducts to Be Removed: Remove portion of ducts indicated to be removed and cap and seal remaining ducts with same or compatible ductwork material.

d. Ducts to Be Abandoned in Place: Cap and seal ducts with same or compatible ductwork material. Provide duct supports as required to ensure proper support of abandoned ducts.

e. Equipment to Be Removed: Disconnect and cap services and remove equipment.

f. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

g. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

3. If pipe, duct, 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.

4. Patch all building penetrations for systems and equipment that are removed.

B. Cutting And Patching

1. All cutting and patching of new and existing construction required for the installation of systems and equipment specified in Division 23 shall be the responsibility of the Division 23 Contractor. All cutting shall be accomplished with masonry saws, drills or similar equipment to provide neat uniform openings.

2. Patch and repair walls, floors, ceilings and roof with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials. All patching shall meet the approval of the Owner's Representative.

3. All cutting and patching made necessary to repair defective equipment, defective workmanship or be neglect of this Contractor to properly anticipate his requirements shall be included in Division 23.

4. Cut carefully to minimize necessity for repairs to existing work. Do not cut beams, columns, or trusses or other structural members without the Owner Representative's written approval.

5. Cutting, patching, repairing, and replacing pavement, sidewalks, roads, and curbs to permit installation of work specified or indicated under this Division is responsibility of Division 23.

3.2 ACCESS DOORS

A. Provide access doors where specialties are not exposed unless indicated to be provided under other Divisions. Access doors shall comply with Division 08. Coordinate size and location with access requirements.

B. Access door locations may occasionally be shown on the drawings, to indicate specific location and/or installation requirements in certain instances. This shall not be construed to indicate that all required access doors have been shown on the drawings. It is the Contractor's responsibility to provide access doors as required.

3.3 DIELECTRIC FITTINGS

A. Provide dielectric fittings whenever connecting piping of dissimilar metals.

3.4 ESCUTCHEONS

A. Install escutcheons for penetrations of walls, ceilings, and floors in finished spaces.

3.5 HOUSEKEEPING PADS

A. Refer to individual specification Sections for equipment requiring housekeeping pads.

B. Construct housekeeping pads of dimensions not less than 4 inches (100 mm) larger in both directions than supported unit. Also ensure minimum concrete coverage around anchor bolts is maintained to meet both anchor bolt manufacturer's requirements and seismic codes.

C. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.

D. Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes.

E. Anchor Bolts

1. Install anchor bolts according to anchor-bolt manufacturer's written instructions and according to seismic codes.
2. Extend anchor bolts through concrete base, and anchor into structural concrete floor.
3. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.6 MECHANICAL SLEEVE SEALS

A. Provide mechanical sleeve seals at the following locations:

1. Below grade wall piping penetrations
2. Slab on grade floor and basement floor piping penetrations.
3. Penetrations of all separations where separation serves as a moisture barrier.

3.7 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

B. Refer to individual specifications Sections for additional paint scope requirements.

3.8 SLEEVES

A. Provide sleeves for above grade duct and piping penetrations of walls, roofs and floors.

1. Exception: Sleeves are not required for core drilled holes.

B. Set sleeves in position in formwork. Provide reinforcing around sleeves.Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous

insulation wrapping, where duct or pipe is to be insulated. Where piping or ductwork penetrates a roof, floor or wall, close off space between pipe or duct and sleeve with fiberglass insulation and sealant (air tight). This applies to all roofs, walls or floors regardless of fire rating. Refer to Division 07 for additional information. Note: 3 lb. insulation not required at roof penetrations. Use fire safeing sealant at penetrations of fire rated floors and walls.

E. Furnish and install waterproof sleeves on all piping and duct penetrations through the floor slabs in mechanical room and any area where pipesand ducts pass through slabs where water spillage could cause damage to ceilings below. Top of sleeve shall extend 2" (51 mm) above floor.

3.9 SUPPORTS AND ANCHORAGES

A. Metal

1. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
2. Field Welding: Comply with AWS D1.1.

B. Wood

1. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.
2. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
3. Attach to substrates as required to support applied loads.

END OF SECTION 3.9

SECTION 230553 - HVAC IDENTIFICATION

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.

B. Section 230000 – General HVAC Requirements

1.2 REFERENCES

A. General

1. ASME A13.1 - Scheme for the Identification of Piping Systems

1.3 SUBMITTALS

A. General

1. Product data for specified materials.
2. Samples: For color, letter style, and graphic representation required for each identification material and device.
3. Valve numbering scheme.

B. Valve Schedules:

1. For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.4 OPERATION AND MAINTENANCE MATERIALS

A. General: Include valve tag identification schedule.

1.5 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.6 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 location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.1 ACCESS PANEL AND DOOR MARKERS:

A. 1/16-inch- (1.6-mm-) thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch (3.2-mm) center hole for attachment.

B. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.2 CEILING TACKS

A. Description: Steel with 3/4-inch (19-mm) diameter color coded head.

B. Color code as follows:

1. HVAC equipment: Yellow
2. Fire dampers/smoke dampers: Red
3. Plumbing valves: Green
4. Heating/cooling valves: Blue

2.3 NAMEPLATES

A. Description: Laminated three-layer plastic with engraved white letters on black background

2.4 PIPE MARKERS

Do not use pipe markers or plastic tapes for bare pipes conveying fluids at temperatures of 125 deg F (52 deg C) or higher.

A. General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with ASME A13.1, unless otherwise indicated.
2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
3. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Full-band pipe markers extending 360 degrees around pipe at each location.
4. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
5. Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe marker to indicate direction of flow.

B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.

D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils (0.08 mm) thick with pressure-sensitive, permanent-type, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): 3/4 inch (19 mm) minimum.
2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches (150 mm) or Larger: 1-1/2 inches (38 mm) minimum.

2.5 TAGS

A. Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers, with numbering scheme as approved. Provide 5/32-inch (4-mm) hole for fastener.

1. Material: 0.032-inch- (0.8-mm-) thick brass.
2. Valve-Tag Fasteners: Brass wire-link or beaded chain, or S-hook.

2.6 VALVE SCHEDULES

A. Valve Schedules: For each piping system, on standard-size 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-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
2. Frame: Extruded aluminum.
3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

PART 3 EXECUTION

3.1 GENERAL

A. Preparation

1. Degrease and clean surfaces to receive adhesive for identification materials.
2. Provide identifying devices after completion of coverings and painting.

B. Adjusting

1. Relocate mechanical identification materials and devices that have become visually blocked by other work.

C. Cleaning

1. Clean faces of mechanical identification devices and glass frames of valve schedules.

3.2 NAMEPLATES

A. For unfinished canvas covering, apply paint primer before applying labels.

B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.

C. Stenciled Equipment Marker Option: Stenciled markers may be provided instead of laminated-plastic equipment markers, at Installer's option, if lettering larger than 1 inch (25 mm) high is needed for proper identification because of distance from normal location of required identification.

3.3 IDENTIFICATION SCHEDULE

A. Identify all scheduled equipment (air handling units, fans, pumps, heat transfer equipment, tanks, etc.) and water treatment devices with plastic nameplates.

B. Identify control panels and major control components outside panels with plastic nameplates.

C. Identify valves in main and branch piping with tags.

D. Identify air terminal units and valves with numbered tags.

E. Tag automatic controls, instruments, and relays. Key to control schematic.

F. Identify piping, concealed or exposed, with plastic pipe markers or plastic tape pipe markers. Identify service, flow direction, and pressure (when applicable). Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

G. Provide ceiling tacks to locate valves, terminal boxes or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 23 05 53

SECTION 230593 - HVAC TESTING, ADJUSTING, AND BALANCING

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.

B. Section 230000 – General HVAC Requirements

1.2 REFERENCES

A. General

1. AABC - National Standards for Total System Balance
2. ADC - Test Code for Grilles, Registers, and Diffusers
3. ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems
4. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems
5. SMACNA - HVAC Systems Testing, Adjusting, and Balancing

1.3 SUBMITTALS

A. Contract Documents Examination Report: Submit copies of the Contract Documents review report as specified in Part 3.

B. Strategies and Procedures Plan: Submit copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.

C. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

D. Sample Report Forms: Submit two sets of sample TAB report forms.

E. Warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by AABC or NEBB.

B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service

representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:
    a. Submittal distribution requirements.
    b. The Contract Documents examination report.
    c. TAB plan.
    d. Work schedule and Project-site access requirements.
    e. Coordination and cooperation of trades and subcontractors.
    f. Coordination of documentation and communication flow.

C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
    1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
    2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard forms NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

E. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
    1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.5 PROJECT CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.6 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 TAB SPECIALISTS

A. Approved TAB Specialists

1. Neodorfer Engineers
2. Precision Air Balance
3. Northwest Engineering Service
4. Others subject to qualifications above, with prior approval.

3.2 EXAMINATION

A. General

1. Verify that systems are complete and operable before commencing work. Ensure that the items on the pre-balance checklist are completed.
2. 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.
3. Examine systems for installed 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 accessible.
4. Examine the approved submittals for HVAC systems and equipment.
5. 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.
6. When used for HVAC distribution, examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Section 233100 and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
7. Examine equipment performance data including fan and pump curves.
    a. 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.

b. 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.

8. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

9. Examine test reports specified in individual system and equipment Sections.

10. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

11. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

12. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

13. When used, examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

14. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

15. Examine system pumps to ensure absence of entrained air in the suction piping.

16. Examine operating safety interlocks and controls on HVAC equipment.

17. 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.

B. Test and Verification of Control System

1. The Air Balance and Testing Agency, with the aid of the Control Contractor, shall verify that the control systems are performing in accordance to the specified criteria.

2. Operation of all components and system sequence shall be verified. Letter of certification shall be forwarded to the Owner’s Representative with copies enclosed in the O&M Manual.

3. This procedure shall not relieve the control contractor of any responsibilities. This paragraph is intended to insure that the control system is completely operational and adjusted at the time the air systems testing and balancing is being accomplished.

3.3 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.

2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

C. Provide instruments required for testing, adjusting, and balancing operations.

3.4 PROCEDURES

A. General

1. All procedures shall be in accordance with and meet all the requirements of either AABC or NEBB procedural standards for all equipment and systems included in the project. The requirements listed in this section are intended to be supplementary to the requirements of these standards.
2. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."
3. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
    a. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
    b. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."
4. 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.
5. Take and report testing and balancing measurements in inch-pound (IP) units.

B. Air Systems

1. General
    a. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck 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 Division 23 Section "Metal Ducts."

2. Constant Volume Systems

a. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

b. Measure total airflow.

1) Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

c. Measure fan static pressures as follows to determine actual static pressure:

1) Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.

2) Measure static pressure directly at the fan outlet or through the flexible connection.

3) Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.

4) Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

d. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

1) Report the cleanliness status of filters and the time static pressures are measured.

e. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.

f. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors.

g. Make required fan speed adjustments. Make all required system alterations to achieve fan speed adjustments, including sheave adjustement and replacement.

1) 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 will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

3. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

a. Measure airflow of submain and branch ducts.

1) Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

b. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.

c. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

4. Measure air outlets and inlets without making adjustments.

a. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

5. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

a. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.

b. Adjust patterns of adjustable outlets for proper distribution without drafts.

6. Constant Flow Systems

a. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:

1) Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

2) Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.

3) Monitor motor performance during procedures and do not operate motors in overload conditions.

4) Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.

5) Report flow rates that are not within plus or minus 10 percent of design.

b. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.

c. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.

d. Set calibrated balancing valves, if installed, at calculated presettings.

e. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1) System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

f. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

g. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1) Determine the balancing station with the highest percentage over indicated flow.

2) Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.

3) Record settings and mark balancing devices.

h. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

i. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.

j. Check settings and operation of each safety valve. Record settings.

7. Variable Flow 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.

8. Supplemental Requirements
    a. Primary-Secondary Systems
        1) Balance the primary circuit flow first and then balance the secondary circuits.
9. Condensing Units
    a. Verify proper rotation of fans.
    b. Measure entering- and leaving-air temperatures.
    c. Record compressor data.

C. Existing Systems
1. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
2. Measure and record the operating speed, airflow, and static pressure of each fan.
    a. Measure motor voltage and amperage. Compare the values to motor nameplate information.
    b. Check the refrigerant charge.
    c. Check the condition of filters.
    d. Check the condition of coils.
    e. Check the operation of the drain pan and condensate-drain trap.
    f. Check bearings and other lubricated parts for proper lubrication.
    g. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
3. 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:
    a. New filters are installed.
    b. Coils are clean and fins combed.
    c. Drain pans are clean.
    d. Fans are clean.
    e. Bearings and other parts are properly lubricated.
    f. Deficiencies noted in the preconstruction report are corrected.
4. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
    a. 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.

b. 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.

c. If calculations increase or decrease the air flow 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.

d. Balance each air outlet.

3.5 TOLERANCES

A. Balance all systems to within plus or minus10% of design parameters. When system performance (available fan and pump flow and pressure, etc.) allows, balance systems so that total system flows are at a minimum of 100% of design parameters, without causing any individual flow location to be more than 10% in excess of design parameters.

3.6 REPORTING

A. Initial Construction-Phase Report

1. 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. Final Report

1. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
   a. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
   b. Include a list of instruments used for procedures, along with proof of calibration.
2. Final Report Contents: In addition to certified field-report data, include the following:
   a. Pump curves.
   b. Fan curves.
   c. Manufacturers' test data.
   d. Field test reports prepared by system and equipment installers.
   e. Other information relative to equipment performance; do not include Shop Drawings and product data.
3. General Report Data: In addition to form titles and entries, include the following data:
   a. Title page.

b. Name and address of the TAB contractor.

c. Project name.

d. Project location.

e. Architect's name and address.

f. Engineer's name and address.

g. Contractor's name and address.

h. Report date.

i. Signature of TAB supervisor who certifies the report.

j. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.

k. Summary of contents including the following:

1) Indicated versus final performance.

2) Notable characteristics of systems.

3) Description of system operation sequence if it varies from the Contract Documents.

l. Nomenclature sheets for each item of equipment.

m. Data for terminal units, including manufacturer's name, type, size, and fittings.

n. Notes to explain why certain final data in the body of reports vary from indicated values.

o. Test conditions for fans and pump performance forms including the following:

1) Settings for outdoor-, return-, and exhaust-air dampers.

2) Conditions of filters.

3) Cooling coil, wet- and dry-bulb conditions.

4) Face and bypass damper settings at coils.

5) Fan drive settings including settings and percentage of maximum pitch diameter.

6) Inlet vane settings for variable-air-volume systems.

7) Settings for supply-air, static-pressure controller.

8) Other system operating conditions that affect performance.

p. Test Data (Indicated and Actual Values):

1) Total air flow rate in cfm (L/s).

2) Entering-air temperature in deg F (deg C).

3) Leaving-air temperature in deg F (deg C).

4) Air temperature differential in deg F (deg C).
5) Entering-air static pressure in inches wg (Pa).
6) Leaving-air static pressure in inches wg (Pa).
7) Air static-pressure differential in inches wg (Pa).
8) Low-fire fuel input in Btu/h (kW).
9) High-fire fuel input in Btu/h (kW).
10) Manifold pressure in psig (kPa).
11) High-temperature-limit setting in deg F (deg C).
12) Operating set point in Btu/h (kW).
13) Motor voltage at each connection.
14) Motor amperage for each phase.
15) Heating value of fuel in Btu/h (kW).

4. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

a. Report Data:

1) System and air-handling-unit number.
2) Location and zone.
3) Traverse air temperature in deg F (deg C).
4) Duct static pressure in inches wg (Pa).
5) Duct size in inches (mm).
6) Duct area in sq. ft. (sq. m).
7) Indicated air flow rate in cfm (L/s).
8) Indicated velocity in fpm (m/s).
9) Actual air flow rate in cfm (L/s).
10) Actual average velocity in fpm (m/s).
11) Barometric pressure in psig (Pa).

5. Instrument Calibration Reports:

a. Report Data:

1) Instrument type and make.
2) Serial number.
3) Application.
4) Dates of use.

5) Dates of calibration.

3.7 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of the designated Owner's Representative.
3. The Owner's Representative 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.
4. 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."
5. 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.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. 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 contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

END OF SECTION 23 05 93

SECTION 23 07 00 - HVAC INSULATION

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.

B. Section 230000 – General HVAC Requirements

1.2 REFERENCES

A. General

1. ASTM C518 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
2. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation
3. ASTM C665
4. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
5. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source
6. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
7. ASTM G22
8. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials
9. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials
10. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials
11. SMACNA - HVAC Duct Construction Standards - Metal and Flexible

B. Glass fiber, Flexible Blanket (Duct Wrap)

1. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

C. Glass Fiber, Flexible (Duct Liner)

1. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material)

1.3 SUBMITTALS

A. General

1. For each insulation type, provide material characteristics, minimum and maximum service temperatures, moisture absorption characteristics, thermal and vapor transmission characteristics.
2. Provide a schedule indicating insulation type and thickness for all pipe sizes of all piping systems.
3. Provide a schedule indicating insulation type and thickness for all equipment to receive insulation.
4. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).
5. Shop Drawings: Show details for the following:
   a. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   b. Attachment and covering of heat tracing inside insulation.
   c. Insulation application at pipe expansion joints for each type of insulation.
   d. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   e. Removable insulation at piping specialties, equipment connections, and access panels.
   f. Application of field-applied jackets.
   g. Application at linkages of control devices.
   h. Field application for each equipment type.

1.4 QUALITY ASSURANCE

A. General

1. Conform to maximum flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, and UL 723.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "HVAC Hangers and Supports."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation

application. Before preparing piping and ductwork 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.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

Part 2 - **PRODUCTS**

2.1 GENERAL

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. For indoor applications, use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 DFR 59, Subpart D (EPA method 24).

2.2 DUCT INSULATION

A. Glass Fiber, Flexible Blanket (Duct Wrap)

1. Manufacturers
    a. Certainteed; Standard Ductwrap
    b. Knauf; Ductwrap
    c. Owens Corning; All Service Ductwrap
    d. Schuller; R-Series Microlite
2. Insulation: ASTM C553; flexible, noncombustible blanket; 'K' ('Ksi') value: ASTM C518, 0.29 at 75 deg F; maximum service temperature: 250 deg F; maximum moisture absorption: 0.20 percent by volume; density: 0.75 lbs/cu ft; resistance to microbial growth: ASTM C665; shall not support mold, bacteria, or fungus growth.

3. Vapor Barrier Jacket: Foil Scrim Kraft (FSK); foil thickness: 0.00035 inches; moisture vapor transmission: ASTM E96; 0.02 perm; Class I vinyl; vinyl thickness: 0.0032 inches; moisture vapor transmission: ASTM E96; 1.3 perm; vapor barrier tape: same material as vapor barrier jacket as recommended by the insulation manufacturer.

B. Glass Fiber, Flexible (Duct Liner)

1. Manufacturers

a. Certainteed - Toughgard

b. Knauf - Duct Liner E-M

c. Schuller - Permacote Linacoustic

2. Insulation: ASTM C1071; flexible, noncombustible bonded glass fiber blanket with a black matt faced surface for damage resistance; 'K' ('Ksi') Value: ASTM C1071, maximum 0.28 at 75 deg F maximum service temperature: 250 deg F; maximum rated air velocity on coated air side: 4,000 fpm; surface coating with EPA registered anti-microbial agent that will not support growth of fungus or bacteria; anti-microbial agent shall be tested in accordance with: fungi test ASTM C665, fungi test ASTM G21, bacterial test ASTM G22.

3. Adhesive:

a. Waterproof, ASTM E162 fire-retardant type

4. Mechanical Fasteners:

a. Conform to SMACNA Mechanical Fastener Standard MF-1-1975

b. Manufacturers
   1) DuroDyne
   2) Omark dished head “Insul-Pins”

c. Grip nails may be used if nail is installed by “Grip Nail Air Hammer” or by “Automatic Fastener Equipment” in accordance with Manufacturer’s recommendations.

C. Glass Fiber, Rigid

1. Manufacturers

a. Schuller, Spin-Glas type 814

2. Insulation: ASTM C612; rigid, noncombustible blanket; 'K' ('Ksi') value : ASTM C518, 0.23 at 75 deg F; maximum service temperature: 450 degrees F; maximum moisture absorption: 1 percent by volume; density: 3.0 lb/cu ft.

2.3 EQUIPMENT INSULATION

A. Manufacturers

1. CertainTeed Corp.; CrimpWrap

2. Johns Manville; MicroFlex

3. Knauf Insulation; Pipe and Tank Insulation
4. Manson Insulation Inc.; AK Flex
5. Owens Corning; Fiberglas Pipe and Tank Insulation

B. Glass Fiber Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

2.4 LACE-ON BLANKETS

A. Manufacturers (Refer to Section 230000):
   1. Insulation
      a. Kaowool Cerablanket
   2. Fabric
      a. JP Stevens Glass-Tex Fabric Style 9987
      b. Alpha Maritex Style 3200-SA

B. Materials: 0.008 inch thick type 304 stainless steel knitted wire mesh inner liner 8 lb/cu.ft. density insulation, ½ inch (13mm) thick; oil and water resistant exterior protective fabric.

C. Construction: Blankets shall be sewn together. Lacing anchors shall be 2½ inch (65 mm) stainless steel secured with 12 gauge (2.5 mm) stainless steel washers. Blankets shall have stainless steel wire installed for draw cords.

2.5 JACKETS AND FITTING COVERS

A. PVC Plastic Jacket and Fitting Covers (Interior Applications):
   1. Manufacturers (Refer to Section 230000):
      a. Zeston 2000
   2. Jackets and fitting covers: ASTM D1784; one piece molded type fitting covers and sheet material; off-white color; minimum service temperature: 0 °F -18 °C; maximum service temperature: 450 °F 230° C; thickness: 20 mil 0.50 mm
   3. Jackets and fitting covers (vapor barrier jackets): ASTM D1784; one piece molded type fitting covers and sheet material; off-white color; minimum service temperature: 0 °F -18 °C; maximum service temperature: 450 °F 230 °C; moisture vapor transmission - ASTM E96 - 0.002 perm-inches 0.0029 ng/(s×m×Pa); thickness: 20 mil 0.50 mm.
   4. Connections: Pressure sensitive color matching vinyl tape

B. Inserts and Shields

1. Inserts: Heavy density insulation which will not crush from weight of pipe. Locate between shield and pipe. Inserts are furnished in this Section and installed in Section 15140.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and insulation. Shields are furnished and installed under Section 230901.

Part 3 - **EXECUTION**

3.1 GENERAL

A. Examination

1. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
2. Verify that systems and equipment to be insulated have been tested and are free of defects.
3. Verify that surfaces to be insulated are clean and dry.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Preparation

1. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
2. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
3. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

C. Installation

1. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
2. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
3. 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.
4. Install insulation with longitudinal seams at top and bottom of horizontal runs.
5. Install multiple layers of insulation with longitudinal and end seams staggered.
6. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

7. Keep insulation materials dry during application and finishing.
8. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
9. Install insulation with least number of joints practical.
10. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
    a. Install insulation continuously through hangers and around anchor attachments.
    b. 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.
    c. 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.
    d. 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.
11. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
12. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
13. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
14. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
15. For above ambient services, do not install insulation to the following:
    a. Vibration-control devices.
    b. Testing agency labels and stamps.
    c. Nameplates and data plates.
    d. Manholes.
    e. Handholes.
    f. Cleanouts.

D. Application

1. Insulation shall be applied in accordance with the requirements of the applicable energy code. Refer to code for minimum required thicknesses.

2. Additional information has been provided in the schedules at the end of this section. It is the intent of this information to help communicate the requirements of the energy code, and to provide supplemental information.
3. Where insulation requirements at the end of this section are more stringent than energy code requirements, the more stringent requirements shall be met.
4. Where insulation requirements at the end of this section are less stringent than the energy code requirements, the more stringent energy code requirements shall be met.
5. For systems that have not been specifically noted in the schedule at the end of this section, energy code requirements shall dictate insulation requirements.
6. Provide lace-on blankets at all valves, unions, strainers and flanges.
7. Provide equipment insulation at all equipment connected to systems requiring insulation that receive fluids at system operating temperature and are not factory insulated to system requirements. This shall include pumps.

E. Penetrations

1. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
    a. Seal penetrations with flashing sealant.
    b. 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.
    c. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
    d. Seal jacket to roof flashing with flashing sealant.
2. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
3. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
    a. Seal penetrations with flashing sealant.
    b. 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.
    c. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
    d. Seal jacket to wall flashing with flashing sealant.
4. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

5. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. 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 (50 mm).
    a. Firestopping and fire-resistive joint sealers are specified in Division 7 Section "Through-Penetration Firestop Systems."
6. Insulation Installation at Floor Penetrations:
    a. Pipe: Install insulation continuously through floor penetrations.
    b. Seal penetrations through fire-rated assemblies according to Division 7.
7. Insulation Installation on Pipe Flanges:
    a. Install preformed pipe insulation to outer diameter of pipe flange.
    b. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
    c. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
    d. Finish flange insulation same as pipe insulation.
8. Insulation Installation on Pipe Fittings and Elbows:
    a. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
    b. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
    c. Finish fittings insulation same as pipe insulation.

3.2 DUCT AND PLENUM INSULATION

A. Glass Fiber, Flexible Blanket (Duct Wrap)
1. Secure with adhesive and insulation pins.
2. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
3. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
4. 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 (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.

b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) 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 overcompress 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.

5. 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 (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) 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 (10 deg C) at 18-foot (5.5-m) 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 2 times the insulation thickness but not less than 3 inches (75 mm).

6. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.

7. 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.

8. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

B. Glass Fiber, Flexible (Duct Liner)

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 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 (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.

    b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) 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 overcompress insulation during installation.

    e. 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 (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) 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 (10 deg C) at 18-foot (5.5-m) 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 2 times the insulation thickness but not less than 3 inches (75 mm).

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

C. Application

1. Refer to General Application requirements earlier in this section, and the schedule information at the end of this section.

3.3 LACE-ON BLANKETS

A. Provide lace-on blankets at all components requiring maintenance access, including but not limited to valves, strainers, flanges, and unions.

3.4 JACKETS AND FITTING COVERS

A. Provide PVC jackets for interior applications, and aluminum jackets for exterior applications.

B. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

C. Where metal jackets are indicated, install with 2-inch (50-mm) 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 (300 mm) o.c. and at end joints.

3.5 EQUIPMENT INSULATION

A. Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints, and 16 inches (400 mm) o.c. in both directions.
    d. Do not overcompress insulation during installation.
5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
7. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

Part 4 - **SCHEDULES**

4.1 DUCT INSULATION SCHEDULE

DUCTWORK INSULATION SCHEDULE			
SERVICE	**INSULATION TYPE**	**THICKNESS** (inches)	**NOTES**
Lined Supply Ductwork - Building Interior	Glass Fiber, Flexible (Duct Liner)	1	3, 4
Wrapped Supply Ductwork - Building Interior	Glass Fiber, Flexible Blanket (Duct Wrap)	1½	1
Lined Supply Ductwork - Building Exterior (including ventilated attic spaces)	Glass Fiber, Flexible (Duct Liner)	2½	3, 4
Wrapped Supply Ductwork - Building Exterior (including ventilated attic spaces)	Glass Fiber, Rigid	2½	1
Lined Return Ductwork - Building Interior	Glass Fiber, Flexible (duct liner)	1	3, 4
Lined Return Ductwork - Building Exterior (including ventilated attic spaces)	Glass Fiber, Flexible (duct liner)	2½	3, 4
Wrapped Return Ductwork - Building Exterior (including ventilated attic spaces)	Glass Fiber, Rigid	2½	2
Combustion Air Ductwork	Glass Fiber, Flexible Blanket (Duct Wrap)	1½	
Lined Outside / Exhaust / Economizer Relief Air Ductwork between insulated wall or roof and indoor equipment or motorized damper	Glass Fiber, Flexible (Duct Liner) And Glass Fiber, Flexible Blanket (Ductwrap)	1 And 3	6
Un-lined Outside / Exhaust / Economizer Relief Air Ductwork (Systems 2800 cfm and greater) between insulated wall or roof and indoor equipment or motorized damper	Glass Fiber, Flexible Blanket (Ductwrap)	4½	6
Lined Outside Air Ductwork (All Systems) between motorized damper and indoor equipment	Glass Fiber, Flexible (Duct liner)	1	
Un-lined Outside Air Ductwork (All Systems) between motorized damper and indoor equipment	Glass Fiber, Flexible Blanket (Ductwrap)	1½	
Notes: 1. All supply ductwork not indicated to be lined shall be wrapped. Exception: exposed ductwork serving only the area in which it is located.			

DUCTWORK INSULATION SCHEDULE			
SERVICE	**INSULATION TYPE**	**THICKNESS** (inches)	**NOTES**
2. All return ductwork exterior to the building (including ventilated attic spaces) not indicated to be lined shall be wrapped. 3. In some areas on the Drawings, duct liner may be indicated to be greater than 1 inch for acoustical purposes. Provide thickness indicated. 4. Where round or flat oval duct is indicated to be lined, see Section 233110 – Ductwork. 5. Insulate systems noted with an installed R-7 insulation system with insulation types and thicknesses indicated. 6. Insulate systems noted with an installed R-11 insulation system with insulation types and thicknesses indicated.			

END OF SECTION 4.1

SECTION 23 31 00 - METAL DUCTS

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.

B. Section 230000 – General HVAC Requirements

1.2 REFERENCES

A. General

1. ASTM A 36 - Structural Steel
2. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
3. ASTM A 366 - Steel, Sheet, Carbon, Cold Rolled, Commercial Quality
4. ASTM A 525 - General Requirements for Steel Sheet, Zinc- Coated (Galvanized) by the Hot-Dip Process
5. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality
6. ASTME 84 - Standard Test Method for Surface Burning Characteristics of Building Material
7. NFPA 90A - Installation of Air Conditioning and Ventilating systems
8. SMACNA - HVAC Air Duct Leakage Test Manual
9. SMACNA - HVAC Duct Construction Standards - Metal and Flexible
10. UL 181 - Factory-Made Air Ducts and Connectors

1.3 SUBMITTALS

A. General

1. Welding certificates.
2. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Construct ductwork to the 1997 Uniform Mechanical Code, and SMACNA, HVAC Duct Construction Standards - Metal and Flexible, Latest Edition

B. In addition to the above standards, construct kitchen ductwork serving type I hoods to NFPA 96 and 1997 UMC standards.

C. In addition to the above standards, construct ductwork from product conveying exhaust systems to NFPA 91 standards.

D. Where more than one standard is referenced, the most restrictive shall apply.

E. Welding: Qualify procedures and personnel according to [AWS D1.1, "Structural Welding Code--Steel," for hangers and supports] [AWS D1.2, "Structural Welding Code--Aluminum," for aluminum supporting members] [and] [AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding].

F. NFPA Compliance:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

G. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, unless otherwise indicated.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

A. 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: Lock-forming quality; complying with ASTM A 653/A 653M and having G60 (Z180) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Stainless Steel: ASTM A 480/A 480M, Type 316 or 304, as specified (use type 316 if not otherwise specified) and having a No. 2D finish.

D. Aluminum Sheets: ASTM B 209 (ASTM B 209M), alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 LOW VELOCITY DUCTWORK AND FITTINGS

A. General

1. Low velocity ductwork shall be defined as all ductwork not specifically defined as medium velocity ductwork.
2. Fabricate, install, and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, the Uniform Mechanical Code, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
3. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Provide turning vanes in all rectangular elbows greater than 45 degrees (unless utilized for return duct stub-outs into return air plenums - no vanes required).
4. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

B. Low velocity plenums

1. Plenums shall be at least two gages heavier than specified ductwork of equal size.
2. Provide access doors to service equipment. Fabricate with 16 gage steel double wall construction with 1 inch (25 mm) thick fiberglass insulation in core. Openings shall be reinforced with welded angle bar frames. Doors shall be pulled airtight on neoprene gaskets.

C. Rectangular Duct and Fitting Fabrication

1. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
    a. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
    b. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
2. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
3. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.
    a. Duct Size: Maximum 30 inches (750 mm) wide and up to 2-inch wg (500-Pa) pressure class.
    b. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.
4. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches (480 mm) and larger and 0.0359 inch (0.9 mm) thick or less, with more than 10 sq. ft. (0.93 sq. m) of nonbraced panel area unless ducts are lined.

D. Round and Flat-Oval Duct and Fitting Fabrication

1. General

   a. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.

   b. Round, Longitudinal- and Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

   c. Flat-Oval, Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Fabricate ducts larger than 72 inches (1830 mm) in diameter with continuously butt-welded longitudinal seams.

2. Duct Joints

   a. Ducts up to 20 Inches (500 mm) in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.

   b. Ducts 21 to 72 Inches (535 to 1830 mm) in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.

   c. Ducts Larger Than 72 Inches (1830 mm) in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.

   d. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.

   e. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.

3. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.

4. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

5. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Unless elbow construction type is indicated, fabricate elbows as follows:

   a. Mitered-Elbow Radius and Number of Pieces: Continuously welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

   b. Round Mitered Elbows: Continuously welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg (minus 500 to plus 500 Pa):

      1) Ducts 3 to 36 Inches (75 to 915 mm) in Diameter: 0.034 inch (0.85 mm).

2) Ducts 37 to 50 Inches (940 to 1270 mm) in Diameter: 0.040 inch (1.0 mm).
3) Ducts 52 to 60 Inches (1320 to 1525 mm) in Diameter: 0.052 inch (1.3 mm).
4) Ducts 62 to 84 Inches (1575 to 2130 mm) in Diameter: 0.064 inch (1.6 mm).

c. Round Mitered Elbows: Continuously welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg (500 to 2500 Pa):

1) Ducts 3 to 26 Inches (75 to 660 mm) in Diameter: 0.034 inch (0.85 mm).
2) Ducts 27 to 50 Inches (685 to 1270 mm) in Diameter: 0.040 inch (1.0 mm).
3) Ducts 52 to 60 Inches (1320 to 1525 mm) in Diameter: 0.052 inch (1.3 mm).
4) Ducts 62 to 84 Inches (1575 to 2130 mm) in Diameter: 0.064 inch (1.6 mm).

d. Flat-Oval Mitered Elbows: Continuously welded construction with same metal thickness as longitudinal-seam flat-oval duct.

e. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.

f. Round Elbows 8 Inches (200 mm) and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.

g. Round Elbows 9 through 14 Inches (225 through 355 mm) in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.

h. Round Elbows Larger than 14 Inches (355 mm) in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.

i. Die-Formed Elbows for Sizes through 8 Inches (200 mm) in Diameter and All Pressures 0.040 inch (1.0 mm) thick with 2-piece continuously welded construction.

j. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.

k. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.

l. Pleated Elbows for Sizes through 14 Inches (355 mm) in Diameter and Pressures through 10-Inch wg (2500 Pa): 0.022 inch (0.55 mm).

2.3 FLEXIBLE DUCTS:

A. Manufacturers:

1. Genflex
2. Thermaflex
3. Thermold

4. Wiremold
5. Hart & Cooley

B. Basis of Design: Thermaflex, Model G-KM.

C. U.L. 181 Class 1 flexible air duct complying with NFPA standard 90A; factory fabricated assembly composed of an inner liner, coated wound spring steel wire, 1 inch (25 mm) thick fiberglass insulation (installed R-value 4.3), and a vapor barrier outer jacket; 6 inches WG (2.50 kPa) positive working pressure and 1 inch WG (250 Pa) negative working pressure for ducts up to 10 inch (254 mm) diameter, 4 inches WG (2.50 kPa) positive working pressure and 1.0 inches WG (250 Pa) negative working pressure for ducts 12 inches to 16 inches (305 to 406 mm) diameter; 4000 fpm (20.3 m/sec) maximum working velocity, 20 degrees F to 200 degrees F (-23 degrees C to 71 degrees C) working temperatures.

2.4 HANGERS AND SUPPORTS

A. Hanger Materials: Galvanized sheet steel or threaded steel rod at the Contractor's option, with the following limitations:

1. Hangers Exposed in Finished Areas: Use threaded rod.
2. Hangers for Medium Pressure Ductwork: Use threaded rod.
3. Hangers for Low Pressure Ductwork greater than 12" diameter round or rectangular with either side greater than 16" in length: Use threaded rod.
4. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
5. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
6. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

B. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

C. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

2.5 SEALANT MATERIALS

A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.

B. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.

C. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.

D. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

E. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following. Medium velocity ducts shall include all supply ductwork between fans and VAV boxes. Medium velocity ductwork shall also include exhaust systems systems with velocities in excess of 1800 fpm.

1. Low Velocity Ducts: 2-inch wg (500 Pa) or 1.5 times the listed external pressure of the fan serving the duct system, whichever is higher.
2. Medium Velocity Ducts: 6-inch wg (1500 Pa) or 1.5 times the listed external pressure of the fan serving the duct system, whichever is higher.

B. All ducts shall be galvanized steel except as follows:

1. Range Hood Exhaust Ducts: Comply with NFPA 96.
    a. Concealed: Carbon-steel sheet.
    b. Exposed: Type 304, stainless steel with finish to match kitchen equipment and range hood.
    c. Continously weld seams and joints.
2. Dishwasher Hood Exhaust Ducts:
    a. Type 304, stainless steel with finish to match kitchen equipment and range hood. Continuously weld seams and joints.
    b. Aluminum, with seams and laps arranged on top of duct.
3. Acid-Resistant (Fume-Handling) Ducts: Type 316 stainless-steel. Continuously weld joints.
4. Underground Ducts: Concrete-encased galvanized steel or PVC-coated galvanized steel with thicker coating on duct exterior.

3.2 DUCT INSTALLATION

A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

B. Install round and flat-oval ducts in lengths not less than 12 feet (3.7 m) unless interrupted by fittings.

C. Install ducts with fewest possible joints.

D. Install fabricated fittings for changes in directions, size, and shape and for connections.

E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches (300 mm), with a minimum of 3 screws in each coupling.

F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

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 (25 mm), plus allowance for insulation thickness.

I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches (38 mm).

N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire or fire/smoke dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 7 Section "Through-Penetration Firestop Systems."

O. Install ducts with hangers and braces designed to withstand, without damage to equipment, seismic force required by applicable building codes. Refer to SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

P. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."

Q. Paint interiors of metal ducts, that do not have duct liner, for 24 inches (600 mm) upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 9 painting Sections.

3.3 SEAM AND JOINT SEALING

A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.

1. For pressure classes lower than 2-inch wg (500 Pa), seal transverse joints.

B. Seal ducts before external insulation is applied.

3.4 HANGING AND SUPPORTING

A. Support horizontal ducts within 24 inches (600 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

B. Support vertical ducts at maximum intervals of 16 feet (5 m) and at each floor.

C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

D. Install concrete inserts before placing concrete.

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:

1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.

3. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round and flat-oval ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than

and equal to 2-inch wg (500 Pa) (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch wg (500 to 2500 Pa).

4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

B. The entire duct system is required to be tested. At the contractor's option, portions of the system may be tested. In these cases, the sum of leakages shall be added to determine the entire system leakage for verification that the entire system is within acceptable leakage limits. No portion of the system shall be made inaccessible until the entire system has been tested.

1. Exceptions

a. In zoned systems, zone ductwork may be covered when the zone has been determined to be within acceptable limits.

b. The Contractor may obtain written approval from the Owner's Representative to cover portions of a system prior to complete system testing. In such cases, the Contractor shall demonstrate that tested portions of the system are such that, when considered in aggregate with the remaining portions of the system, acceptable leakage rates will be achieved assuming remaining test results are similar to those obtained in the area to be covered.

3.6 CLEANING NEW SYSTEMS

A. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.

B. Use service openings, as required, for physical and mechanical entry and for inspection.

1. Create other openings to comply with duct standards.

2. Disconnect flexible ducts as needed for cleaning and inspection.

3. Remove and reinstall ceiling sections to gain access during the cleaning process.

C. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.

D. Clean the following metal duct systems 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, and actuators except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.

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.
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.

F. Cleanliness Verification:

1. Visually inspect metal ducts for contaminants.
2. Where contaminants are discovered, re-clean and reinspect ducts.

3.7 CLEANING EXISTING SYSTEMS

A. Use service openings, as required, for physical and mechanical entry and for inspection.

1. Use existing service openings where possible.
2. Create other openings to comply with duct standards.
3. Disconnect flexible ducts as needed for cleaning and inspection.
4. Reseal rigid fiberglass duct systems according to NAIMA recommended practices.
5. Remove and reinstall ceiling sections to gain access during the cleaning process.

B. Mark position of dampers and air-directional mechanical devices before cleaning, and restore to their marked position on completion.

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 the outside, use filtration to contain debris removed from HVAC system, and locate exhaust down wind and away from air intakes and other points of entry into building.

D. Clean the following metal duct systems 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, and actuators 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.
    1) Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
    2) 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.
    3) 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.
    4) Provide operative drainage system for washdown procedures.
    5) Biocidal Agents and Coatings: Apply biocidal agents if fungus is present. Apply biocidal agents according to manufacturer's written instructions after removal of surface deposits and debris.

b. Cleanliness Verification:

1) Verify cleanliness after mechanical cleaning and before application of treatment, including biocidal agents and protective coatings.

VISUALLY INSPECT METAL DUCTS FOR CONTAMINANTS.

2) Where contaminants are discovered, re-clean and reinspect ducts.

c. Gravimetric Analysis: At discretion and expense of Owner, sections of metal duct system, chosen randomly by Owner, may be tested for cleanliness according to NADCA vacuum test gravimetric analysis.

1) If analysis determines that levels of debris are equal to or lower than suitable levels, system shall have passed cleanliness verification.
2) If analysis determines that levels of debris exceed suitable levels, system cleanliness verification will have failed and metal duct system shall be re-cleaned and re-verified.

d. Verification of Coil Cleaning: Cleaning must restore coil pressure drop to within 10 percent of pressure drop measured when coil was first installed. If original pressure drop is not known, coil will be considered clean only if it is free of foreign matter and chemical residue, based on thorough visual inspection.

END OF SECTION 23 31 00

SECTION 23 33 00 - DUCT ACCESSORIES

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.

B. Section 230000 – General HVAC Requirements

1.2 REFERENCES

A. General

1. NFPA 90A - Installation of Air Conditioning and Ventilating Systems
2. NFPA 92A - Smoke Control Systems
3. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease Laden Vapors for Commercial Coding Equipment
4. SMACNA - HVAC Duct Construction Standards - Metal and Flexible
5. UL 33 - Heat Responsive Links for Fire-Protection Service
6. UL 555 - Fire Dampers and Ceiling Dampers
7. UL 555S - Leakage Rated Dampers for Use in Smoke Control Systems

1.3 SUBMITTALS

A. General

1. Product data for specified materials.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.5 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. Fire and Fire/Smoke Dampers

1. Fusible Links: Furnish quantity equal to 10% of amount installed for each temperature rating.

1.6 DRAWING SCHEDULES

A. Refer to equipment schedules on drawings for additional information.

PART 2 - PRODUCTS

2.1 BACKDRAFT DAMPERS

A. Manufacturers

1. Air Control Products
2. American Warming and Ventilation
3. Greenheck
4. Pottorff
5. Ruskin

B. Description: Multiple-blade; parallel action; gravity balanced; center-pivoted blades of maximum 6-inch (150-mm) width; sealed edges; assembled in rattle-free manner with 90-degree stop; steel ball bearings and axles; adjustment device to permit setting for varying differential static pressure.

C. Construction: 0.063-inch- (1.6-mm-) thick extruded aluminum frame with welded corners and mounting flange; 0.050-inch- (1.2-mm-) thick aluminum sheet blades; neoprene blade seals; galvanized steel blade axles; aluminum tie bars and brackets; adjustable tension return spring.

2.2 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.3 DUCT-MOUNTING ACCESS DOORS

A. Manufacturers

1. CESCO Products
2. Ductmate Industries, Inc.
3. Elmdor
4. Greenheck
5. McGill AirFlow Corporation
6. Nailor Industries Inc
7. Pottorff
8. Ventfabrics, Inc.
9. Durodyne

B. General Description: Fabricate doors airtight and suitable for duct pressure class.

C. Standard Access Door: Double wall; duct mounting; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class; 1-by-1-inch (25-by-25-mm) butt or piano hinge, and cam latches; galvanized sheet steel frame with bend-over tabs and foam gaskets.

1. Provide number of hinges and locks as follows:

a. Less Than 12 Inches (300 mm) Square: Secure with two sash locks.

b. Up to 18 Inches (450 mm) Square: Two hinges and two sash locks.

c. Up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches.

d. Sizes 24 by 48 Inches (600 by 1200 mm) and Larger: One additional hinge.

D. Pressure Relief Access Door: Double wall and duct mounting; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class; latches and retaining chain; galvanized sheet steel frame with bend-over tabs and foam gaskets; seal around frame attachment to duct and door to frame with neoprene or foam rubber; 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board when used on insulated duct.

2.4 FIRE AND SMOKE DAMPERS

A. Manufacturers

1. Air Balance
2. Cesco
3. Greenheck
4. Nailor Industries, Inc
5. Pottorff
6. Ruskin

B. Fire Dampers: Roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel frame with mitered and interlocking corners; galvanized sheet steel sleeve of 0.052 or 0.138 inch (1.3 or 3.5 mm) minimum thickness and of length to suit application; stainless steel closure springs; heat retardant non-asbestos retardant blanket as required; roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel blades; replaceable fusible link. Labeled in accordance with UL 555.

C. Combination Fire/Smoke Dampers: Roll-formed, 0.064-inch- (1.62-mm-) thick galvanized steel frame with mitered and interlocking corners; galvanized sheet steel sleeve of 0.052 or 0.138 inch (1.3 or 3.5 mm) minimum thickness and of length to suit application; stainless steel closure springs; roll-formed, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel blades; stainless steel blade edge seals; replaceable fusible link; actuators manufactured by Belimo with integral spring return mechanism; enclose spring mechanism in removable housing designed for service or adjustments; end switches on actuator; leakage class I or II as indicated on drawings;

damper closure shall be controlled through actuator to close the damper in no less than 7 seconds and no greater than 15 seconds. Labeled in accordance with UL 555 and UL 555S.

D. Smoke Dampers: Roll-formed, 0.064-inch- (1.62-mm-) thick galvanized steel frame with mitered and interlocking corners; galvanized sheet steel sleeve of 0.052 or 0.138 inch (1.3 or 3.5 mm) minimum thickness and of length to suit application; stainless steel closure springs; roll-formed, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel blades; stainless steel blade edge seals; actuators manufactured by Belimo with integral spring return mechanism; enclose spring mechanism in removable housing designed for service or adjustments; end switches on actuator; leakage class I or II as indicated on drawings; damper closure shall be controlled through actuator to close the damper in no less than 7 seconds and no greater than 15 seconds. Labeled in accordance with UL 555S.

2.5 FLEXIBLE CONNECTORS

A. Manufacturers

1. American Warming and Ventilating
2. CESCO Products
3. Ductmate Industries, Inc.
4. Greenheck
5. McGill AirFlow Corporation
6. Nailor Industries Inc.
7. Pottorff
8. Ventfabrics, Inc.

B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2-inches (89-mm-) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Select metal compatible with ducts.

D. Flexible Connector Fabric

1. Indoor Applications: Glass fabric double coated with neoprene; 26 oz./sq. yd. (880 g/sq. m) minimum weight; 480 lbf/inch (84 N/mm) tensile strength in the warp and 360 lbf/inch (63 N/mm) in the filling; minus 40 to plus 200 deg F (minus 40 to plus 93 deg C) service temperature.
2. Outdoor Applications: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone; 24 oz./sq. yd. (810 g/sq. m) minimum weight; 530 lbf/inch (93 N/mm) tensile strength in the warp and 440 lbf/inch (77 N/mm) in the filling; minus 50 to plus 250 deg F (minus 45 to plus 121 deg C) service temperature.
3. High Temperature Applications: Glass fabric coated with silicone rubber; 16 oz./sq. yd. (542 g/sq. m) minimum weight; 285 lbf/inch (50 N/mm) tensile strength in the warp and

185 lbf/inch (32 N/mm) in the filling; minus 67 to plus 500 deg F (minus 55 to plus 260 deg C) service temperature.

4. High-Corrosive-Environment Systems: Glass fabric with chemical-resistant coating; 14 oz./sq. yd. (474 g/sq. m) minimum weight; 450 lbf/inch (79 N/mm) tensile strength in the warp and 340 lbf/inch (60 N/mm) in the filling; minus 67 to plus 500 deg F (minus 55 to plus 260 deg C) service temperature.

2.6 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G60 (Z180) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Stainless Steel: ASTM A 480/A 480M.

D. Aluminum Sheets: ASTM B 209 (ASTM B 209M), alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: ASTM B 221 (ASTM B 221M), alloy 6063, temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.7 TURNING VANES

A. Manufacturers

1. American Warming and Ventilating
2. CESCO Products
3. Ductmate Industries, Inc.
4. Elmdor
5. Greenheck
6. McGill AirFlow Corporation
7. Nailor Industries Inc.
8. Potorff
9. United McGill
10. Ventfabrics, Inc.

B. Single Vane Construction: 1-1/2-inch- (38-mm-) wide; single-vane; curved blades of galvanized sheet steel set 3/4 inch (19 mm) o.c.; supported with bars perpendicular to blades set 2 inches (50 mm) o.c.; and set into vane runners suitable for duct mounting.

C. Double Vane Construction: High efficiency; double vane; 2 inch (50 mm) long airfoil leading edge; 3 inch (75 mm) long airflow trailing edge.

1. Basis of Design: AeroDyne H-E-P.

D. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.8 VOLUME BALANCING DAMPERS

A. Manufacturers

1. American Warming and Ventilation
2. Greenheck
3. Pottorff
4. Ruskin
5. Durodyne

B. General Description: Factory fabricated with required hardware and accessories; damper blades stiffened for stability; locking device to hold single-blade dampers in a fixed position without vibration; duct penetrations for damper components sealed consistent with pressure class.

1. Pressure Classes of 3-Inch wg (750 Pa) or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.

C. Standard Volume Dampers: Hat-shaped galvanized sheet steel channel steel frame, minimum of 0.064 inch (1.62 mm) thick with mitered and welded corners; 0.064-inch- (1.62-mm-) thick roll-formed galvanized sheet steel blades; galvanized steel blade axles; oil-impregnated bronze bearing; galvanized steel tie bars and brackets; standard leakage rating; suitable for horizontal or vertical applications.

D. Low-Leakage Volume Dampers: Hat, U, or angle-shaped, galvanized sheet steel channel steel frame, minimum of 0.064 inch (1.62 mm) thick with mitered and welded corners; 0.064-inch- (1.62-mm-) thick roll-formed galvanized stainless sheet steel galvanized steel blade axles; oil-impregnated bronzebearings, thrust or ball type; vinyl blade seals; cambered stainless steel jamb seals; galvanized steeltie bars and brackets; low leakage rating; suitable for horizontal or vertical installation.

E. Jackshaft: 1-inch- (25-mm-) diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

F. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel and a 3/4-inch (19-mm) hexagon locking nut; center hole to suit damper operating-rod size; elevated platform for insulated duct mounting.

PART 3 - EXECUTION

3.1 GENERAL

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible".

3.2 ACCESS DOORS

A. Application

1. Provide access doors (in building walls, ceilings, etc.) as required to access all system components that require maintenance. While Division 08 has been referenced for material specifications, doors shall be furnished and installed by Division 23. It is the Contractor's responsibility to determine required quantities and locations of access doors based on the as-installed conditions and coordination with other trades.

3.3 BACKDRAFT DAMPERS

A. Application

1. Provide backdraft dampers at all outside air intake and exhaust air outlet locations including, but not limited to, louvers, cowls, goosenecks and fans discharging to the outdoors.

a. When equipment at point of termination (louver, fan, cowl, etc.) has been indicated to be provided with backdraft dampers, supplemental backdraft dampers are not required unless specifically noted.

b. When equipment at point of termination (louver, fan, cowl, etc.) has not been indicated to be provided with backdraft dampers, provide backdraft dampers in accordance with this section in the ductwork connecting to the equipment at the point of termination. Damper shall be located as close to the equipment as possible.

3.4 DUCT ACCESSORY HARDWARE

A. Application

1. Provide duct accessories of materials suited to duct materials. Use galvanized-steel accessories in galvanized-steel duct systems, stainless-steel accessories in stainless-steel duct systems, and aluminum accessories in aluminum duct systems.

2. Provide test holes at fan inlets and outlets and elsewhere as indicated.

3.5 DUCT-MOUNTING ACCESS DOORS

A. General

1. Label access doors according to Division 23 Section "HVAC Identification."

B. Application

1. Standard Access Door

a. Provide where required for testing and balancing purposes.

b. Provide where required to provide access to all system components that require maintenance.

c. At a minimum, provide at the following locations:

1) On both sides of duct coils, filters, and in-line fans.
2) Adjacent to motorized control dampers.
3) Adjacent to fire, fire/smoke, and smoke dampers, providing access to reset or reinstall fusible links.
4) Downstream of all duct-mounted equipment
5) To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot (15-m) spacing.

2. Pressure Relief Access Door

a. Provide downstream of all fire, fire/smoke and smoke dampers in medium pressure duct systems.

3.6 FIRE AND SMOKE DAMPERS

A. General

1. Install fire and smoke dampers according to manufacturer's UL-approved written instructions.

2. Provide standard access and pressure relief access doors as required by applicable codes and specified elsewhere in this section.

B. Application

1. Provide fire dampers at all duct penetrations of fire rated assemblies.

2. Provide smoke dampers at all duct penetrations of smoke rated assemblies.

3. Provide fire/smoke dampers at all duct penetrations of fire and smoke rated assemblies.

C. Demonstration

1. Demonstrate access to dampers, visual inspection of damper operation, and re-setting of dampers during training period.

3.7 FLEXIBLE CONNECTORS

A. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.

B. For fans developing static pressures of 5-inch wg (1250 Pa) and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

3.8 FLEXIBLE DUCTS

A. Connect terminal units to rigid supply ducts directly or with maximum 12-inch (300-mm) length of flexible duct. Do not use flexible ducts to change directions. Install flexible duct taught and straight

B. Connect diffusers or light troffer boots to low pressure ducts directly or with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place. Do not use flecible ducts to create bends greater than 45°.

C. Connect flexible ducts to metal ducts with draw bands.

3.9 MOTORIZED CONTROL DAMPERS

A. Application

1. Coordinate with 230900 for damper quantities, locations, and installation requirements.
2. Install motorized control dampers for which material specifications have been provided in 230900.

3.10 TURNING VANES

A. Application

1. Provide turning vanes in all elbows that are not radiused for all duct systems. Use single vane construction for low velocity systems and double vane construction for medium velocity systems.
    a. Exception: Do not provide turning vanes in Type I kitchen exhaust, clothes dryer exhaust, or other product-conveying systems.
2. Refer to 233110 for additional application information.

3.11 VOLUME BALANCING DAMPERS

A. Installation

1. Install dampers in ducts with liner to avoid damage to and erosion of duct liner.
2. Install with sufficient clearance from duct transitions and other equipment to prevent binding.
3. Install at a minimum of two duct widths from branch takeoff.
4. Where dampers are installed above inaccessible ceilings, provide concealed damper regulator and coverplate.

B. Application

1. Provide at points on low pressure supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Use standard volumd dampers unless noted to be low leakage volume dampers.

2. Provide for each GRD in the ductwork serving that GRD, whether indicated on the drawings or not. Optional register dampers provided as an accessory to GRD's are not an acceptable alternative, unless such accessory dampers are scheduled on the drawings and supplementary balancing dampers are not shown on the floor plan drawings. Use standard volumd dampers unless noted to be low leakage volume dampers.

C. Install duct test holes where indicated and required for testing and balancing purposes.

END OF SECTION 23 33 00

SECTION 23 37 10 - GRILLES, REGISTERS, AND DIFFUSERS

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.

B. Section 230000 – General HVAC Requirements

C. Section 09900 – Paints and Coatings

1.2 REFERENCES

A. General

1. AAMA 605.2 - Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels
2. ADC 1062 - Certification, Rating and Test Manual
3. AMCA 500 - Test Method for Louvers, Dampers and Shutters
4. SMACNA - HVAC Duct Construction Standard - Metal and Flexible

B. Air Inlets/Outlets

1. ARI 650 - Air Outlets and Inlets
2. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets

1.3 SUBMITTALS

A. General

1. Product Data: For each product indicated, include the following:
   a. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.

B. Grilles, Registers, and Diffusers Schedule

1. Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.

1.5 DRAWING SCHEDULES

A. Refer to drawings for specific capacities, dimensions, accessories, and other requirements supplemental to these specifications.

PART 2 - PRODUCTS

2.1 GENERAL

A. Dampers: Provided as an accessory to GRD's when scheduled on the drawings. Dampers shall be opposed blade, heavy gauge steel, and shall be adjustable from the face of the inlet or outlet.

B. Frame types and mounting hardware: Coordinated with ceiling types. Architectural plans shall take precedence when referencing ceiling types, and Contractor shall reference the architectural plans for verification of ceiling type prior to ordering.

C. Finish: White unless noted otherwise on the drawings.

2.2 GENERAL GRILLES, REGISTERS, AND DIFFUSERS

A. Manufacturers

1. Anemostat
2. Krueger
3. Pottorff
4. Price
5. Titus
6. Tuttle & Bailey

B. Sidewall Supply Grilles (Double Deflection): Steel, aluminum, or stainless steel construction as scheduled on the drawings; 1 1/4 inch (32 mm) border with fully welded corners; blades in both the long and short dimension with spacing as scheduled on the drawings; individually adjustable blades with steel friction pivots on both ends to allow adjustment without loosening or rattling; countersunk screw mounting holes.

1. Basis of design: Titus 300/301 Series

C. Return Grilles: Steel, aluminum, or stainless steel construction as scheduled on the drawings; 1 1/4 inch (32 mm) border with fully welded corners; fixed blades parallel to the long dimension with spacing and deflection as scheduled on the drawings; countersunk screw mounting holes for surface mount; no mounting holes for lay-in mount.

1. Basis of design: Titus 350/355 Series

D. Modular Core Ceiling Diffusers: Steel or aluminum construction; minimum 1 inch (25 mm) depth for duct connection; 4 fixed louver directional modules, individually removable and adjustable without tools.

1. Basis of design: Titus MCD Series

PART 3 - EXECUTION

3.1 GENERAL

A. Examination

1. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
2. Proceed with installation only after unsatisfactory conditions have been corrected.
3. Check locations and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement. Locate in accordance with architectural reflected ceiling plan when indicated.

B. Installation

1. Check locations and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement. Locate in accordance with architectural reflected ceiling plan when indicated.
2. Install diffusers, registers, and grilles level and plumb.
3. 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 practicable. 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.
4. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire and fire/smoke dampers.
5. Paint ductwork visible behind GRD's matte black in accordance with the requirements of Division 09.
6. Fasten all pan and lay-in style diffusers in lay-in ceilings with earthquake tabs.
7. Provide volume balancing dampers for each GRD in the ductwork serving that GRD, whether indicated on the drawings or not. Optional register dampers provided as an accessory to GRD's are not an acceptable alternative, unless such accessory dampers are scheduled on the drawings and supplementary balancing dampers are not shown on the floor plan drawings.

C. Adjusting

1. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 10

23 81 36 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. LG

2.2 INDOOR UNITS (5 TONS (18 kW) OR LESS)

A. Wall-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 206/110.
3. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
4. Fan: Direct drive, centrifugal.
5. 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: Totally enclosed, fan cooled.
d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
f. Mount unit-mounted disconnect switches on exterior or interior of unit.

6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
7. Condensate Drain Pans:

a. Fabricated with [one] [two] 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.

1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
2) Depth: A minimum of 1 inch (25 mm) deep.

b. Double-wall, galvanized-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

1) Minimum Connection Size: NPS 1 (DN 25).

d. Pan-Top Surface Coating: Asphaltic waterproofing compound.

8. Air Filtration Section:

a. General Requirements for Air Filtration Section:

1) Comply with NFPA 90A.
2) Minimum 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. Extended-Surface, Disposable Panel Filters:

1) Factory-fabricated, dry, extended-surface type.
2) Thickness: 1 inch (25 mm).
3) MERV according to ASHRAE 52.2: 7.
4) Media: Fibrous material formed into deep-V-shaped pleats with antimicrobial agent and held by self-supporting wire grid.
5) Media-Grid Frame: Nonflammable cardboard.
6) Mounting Frames: Welded, galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

B. Variable-Frequency Controllers:

1. Description: NEMA ICS 2, IGBT, PWM, VFC; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, three-phase induction motor by adjusting output voltage and frequency.
2. Output Rating: Three-phase; 6 to [60 Hz, with voltage proportional to frequency throughout voltage range] [66 Hz, with torque constant as speed changes] [120 Hz, with horsepower constant throughout speed range].
3. Unit Operating Requirements:
   a. Input-frequency tolerance of 06/11 Hz, plus or minus 6 percent.
   b. Minimum Efficiency: 96 percent at 60 Hz, full load.
   c. Minimum Displacement Primary-Side Power Factor: 96 percent.
   d. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
   e. Starting Torque: 100 percent of rated torque or as indicated.
   f. Speed Regulation: Plus or minus 1 percent.
4. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.
5. Internal Adjustability Capabilities:
   a. Minimum Speed: 5 to 25 percent of maximum rpm.
   b. Maximum Speed: 80 to 100 percent of maximum rpm.
   c. Acceleration: 2 seconds to a minimum of 22 seconds.
   d. Deceleration: 2 seconds to a minimum of 22 seconds.
   e. Current Limit: 50 percent to a minimum of 110 percent of maximum rating.
6. Self-Protection and Reliability Features:
   a. Input transient protection by means of surge protection devices (SPDs).
   b. Undervoltage and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
   c. Adjustable motor overload relays capable of NEMA ICS 2, Class 10 performance.
   d. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
   e. Instantaneous line-to-line and line-to-ground overcurrent trips.
   f. Loss-of-phase protection.
   g. Reverse-phase protection.
   h. Short-circuit protection.
   i. Motor overtemperature fault.
7. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads, spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.
8. Power-Interruption Protection: Prevents motor from re-energizing after a power interruption until motor has stopped.
9. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

10. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back, based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
11. Door-mounted, digital status lights shall indicate the following conditions:

    a. Power on.
    b. Run.
    c. Overvoltage.
    d. Line fault.
    e. Overcurrent.
    f. External fault.

12. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual-speed-control potentiometer and elapsed-time meter.
13. Meters or digital readout devices and selector switch, mounted flush in controller door and connected, to indicate the following controller parameters:

    a. Output frequency (Hertz).
    b. Motor speed (rpm).
    c. Motor status (running, stop, fault).
    d. Motor current (amperes).
    e. Motor torque (percent).
    f. Fault or alarming status (code).
    g. Proportional-integral-derivative feedback signal (percent).
    h. DC-link voltage (volts dc).
    i. Set-point frequency (Hertz).
    j. Motor output voltage (volts).

14. Control Signal Interface:

    a. Electric Input Signal Interface: A minimum of two analog inputs (0 to 10 V or 0/4-20 mA) and six programmable digital inputs.
    b. Remote signal inputs capable of accepting any of the following speed-setting input signals from the control system:

        1) 0 to 10-V dc.
        2) 0-20 or 4-20 mA.
        3) Potentiometer using up/down digital inputs.
        4) Fixed frequencies using digital inputs.
        5) RS485.
        6) Keypad display for local hand operation.

    c. Output signal interface with a minimum of one analog output signal (0/4-20 mA), which can be programmed to any of the following:

        1) Output frequency (Hertz).
        2) Output current (load).
        3) DC-link voltage (volts dc).

4) Motor torque (percent).
5) Motor speed (rpm).
6) Set-point frequency (Hertz).

d. Remote indication interface with a minimum of two dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

1) Motor running.
2) Set-point speed reached.
3) Fault and warning indication (overtemperature or overcurrent).
4) High- or low-speed limits reached.

15. Communications: RS485 interface allows VFC to be used with an external system within a multidrop LAN configuration. Interface shall allow all parameter settings of VFC to be programmed via BMS control. Provide capability for VFC to retain these settings within the nonvolatile memory.
16. Integral Disconnecting Means: with lockable handle.
17. Accessories:

a. Devices shall be factory installed in controller enclosure unless otherwise indicated.
b. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.
c. Standard Displays:

1) Output frequency (Hertz).
2) Set-point frequency (Hertz).
3) Motor current (amperes).
4) DC-link voltage (volts dc).
5) Motor torque (percent).
6) Motor speed (rpm).
7) Motor output voltage (volts).

2.3 OUTDOOR UNITS (5 TONS (18 kW) OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

a. Compressor Type: Scroll.
b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
c. Refrigerant: R-410A.

d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.

3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 45 deg F (7 deg C).
7. Mounting Base: Polyethylene.

2.4 ACCESSORIES

A. Control equipment and sequence of operation are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."

B. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

C. Thermostat: Wireless infrared functioning to remotely 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.

D. Automatic-reset timer to prevent rapid cycling of compressor.

E. 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.

F. Drain Hose: For condensate.

G. Monitoring:

1. Monitor constant and variable motor loads.
2. Monitor variable-frequency-drive operation.
3. Monitor economizer cycle.
4. Monitor cooling load.
5. Monitor air distribution static pressure and ventilation air volumes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.

D. Equipment Mounting:

1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in [Section 033000 "Cast-in-Place Concrete."] [Section 033053 "Miscellaneous Cast-in-Place Concrete."]
2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
3. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
4. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

1. Water Coil Connections: Comply with requirements specified in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Connect hydronic piping to supply and return coil connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
2. Remote, Water-Cooled Condenser Connections: Comply with requirements specified in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Connect hydronic piping to supply and return connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply[and return] ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. 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.

C. 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.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 23 81 26

SECTION 26 01 26 - ACCEPTANCE TESTING OF ELECTRICAL SYSTEMS

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.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. Provide all apparatus and material required for testing. Use installation tools and test equipment which are designed for the specific task and shall use this equipment per the manufacturer's instructions. All test equipment shall have current calibration certification by a third-party calibration laboratory, and shall have a signed and dated calibration sticker affixed to the device. Calibration shall be traceable to the National Bureau of Standards and be less than 12 months since last calibration. Defective test equipment and installation tools shall not be used. Installation tools such as torque wrenches shall be calibration certified.

PART 3 - EXECUTION

3.1 GENERAL

A. Test, inspect, calibrate, adjust electrical distribution system and generation equipment. Provide written certification on company letterhead that the entire electrical installation complies with contract documents, code and proper system operation. Perform acceptance tests in accordance with manufacturer's recommendations, NFPA 70B and International Electrical Testing Association (NETA) testing specifications NETA ATS-2013.

B. Notify Architect 10 working days prior to performance of any test.

C. Provide project documents to entity responsible for testing prior to testing. As a minimum include:

1. Division 26 Specification
2. Electrical Floor Plans showing equipment to be tested.
3. Electrical One Line Diagrams
4. Submittals of Manufacturers Data and Shop Drawings including engineers review letter of all systems to be tested.
5. Coordination Study and device settings for all adjustable devices

3.2 START UP TESTING

A. Verify system bonding and grounding.

B. Phase Relationship Tests: Check connections to all new and existing three-phase equipment for proper phase relationship. Disconnect all devices which could be damaged by the application of voltage or reversed phase sequence.

3.3 EQUIPMENT TESTING

A. Perform all equipment and device testing after installation and prior to substantial completion or owner occupancy, allowing enough time for corrective action of all deficiencies. Equipment shall be placed in service only after completion of required tests and evaluation of the test results has been completed.

B. Test new electrical equipment.

C. Review manufacturer's installation instruction and confirm that equipment is installed in accordance with manufacturer's instructions. Perform tests under the supervision of a manufacturer's authorized representative when required by manufacturer's instructions.

D. Prior to performing tests confirm that the equipment is clean and free of construction debris and dust.

E. Verify equipment to be energized does not have phase to phase or phase to ground impedances that indicate the presence or likely occurrence of a fault.

F. Perform acceptance tests and inspections in accordance with NETA ATS and the manufacturer's recommendations for the specification sections listed below. Refer to each specification section for supplemental testing.

1. Section 26 05 19 Low Voltage Electrical Power Conductors and Cables
2. Section 26 09 43 Lighting Controls
3. Section 26 24 16 Panelboards
4. Section 26 27 26 Wiring Devices

G. Test the open/close or energize/de-energize operation of each switch, circuit breaker, contactor and other item of electrical control with the systems fully energized and operating. Each shall be tested three times. Test report shall include a list of equipment tested and the signed initials of the electricians performing the test on a device by device basis.

3.4 ENERGY CODE COMPLIANCE

A. Test and Commission systems as required by applicable energy codes and prior to substantial completion.

B. Submit documentation to building officials for acceptance.

3.5 POWER SYSTEM OPERATIONAL TESTING

A. Perform tests 4 to 8 weeks after substantial completion, and at such time that the facility is functioning according to its intended use with the highest available daily loading. Unless otherwise determined this shall be a weekday between 8:00AM and 4:00PM.

B. Grounded Conductor Tests: At the main service and at all separately derived systems test and record the neutral return current and the bonding jumper current.

C. Motor Tests: Check all motors and measure actual load current. Submit tabulation of motor currents for all motors **1** HP or more after the HVAC system has been balanced. The load current may be obtained from VFD displays or the building mechanical control system if it is available.

3.6 RETESTING

A. Any fault in material or in any part of the installation revealed by these tests shall be investigated, replaced or repaired by the Contractor and the same test repeated until no fault appears.

B. If a system or device provided under this contract does not operate per manufacturers specifications provide qualified men with tools and test equipment to analyze and repair problem or deficiency.

3.7 TEST REPORTS

A. Prepare test reports including description of project, description of equipment tested, description of test, test results, conclusions and recommendations, retesting results and list of test equipment used and calibration date.

B. One copy of each test report shall be delivered directly to the electrical engineer and Owner within 7 calendar days of the test.

C. Insert a copy of each test report in the operation and maintenance manuals.

3.8 LABELS

A. Upon completion of the tests, a label shall be attached to all serviced devices. Indicate testing company name, testing date and expiration date.

3.9 SYSTEM ACCEPTANCE

A. Final acceptance of the system is contingent upon satisfactory completion of acceptance tests and inspections.

END OF SECTION 26 01 26

SECTION 26 05 10 - EXISTING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 and Division 02 Specification Sections, apply to this Section.

1.2 RELATED WORK

A. Same as in Section 260500 - Common Work Results For Electrical.

1.3 INDICATED EXISTING SYSTEMS

A. The electrical drawings show portions of the existing electrical systems which are to remain, be removed or be modified. The existing information is derived from record drawings and other data obtained from or with the permission of the owner. Where indicated, concealed systems are also derived from record drawings and the Engineer's best judgment of the configuration.

B. The Contractor shall inspect the existing installation prior to bidding and shall judge the work required. Inspection shall include areas within and adjacent to the work of any discipline or trade performing work for the contract.

C. The complete extent of the existing systems could not be verified during creation of the construction documents. Unless the contractor's inspection of the existing system determines a greater amount, the contractor shall assume there is 20% more existing electrical systems than what is indicated on the contract drawings.

1.4 POWER OUTAGES

A. This facility will be in operation 24 hours a day seven days a week during the construction work; therefore it is required that the Contractor fully schedule electrical system(s) outages with the Owner. Contractor shall work closely with Owner to assure the Owner fully understands the extent of each outage. Owner maintains the right to limit the extent and length of any given outage. Assume all outages to Electrical system(s) in Owner occupied areas will require premium time and that temporary electrical work may be required to limit the duration of outages.

B. Cutovers must make alternative arrangements to deliver power to the load at all times

C. Submit a written request for a power outage at least two weeks in advance identifying the areas and systems that will be affected, time and duration of the power outage. The Contractor shall receive written authorization to proceed with the outage and shall re-notify the Owner verbally at least one hour prior to the outage and also notify the Owner when the outage is completed.

D. Temporary generator(s) will be required for any work that takes the existing generator system out of service or off-line from any portion of the emergency power distribution. Temporary generation shall include automated controls and wiring to interface with the existing system.

E. Unscheduled Outages: In the event that the Contractor's work causes or contributes to an electrical system(s) outage (or other system fault), the Contractor is responsible for immediately correcting the problem. Included (as examples) shall be any premium time required to stay on the job site until problem is corrected and air freight for parts not locally available. Any damage resulting from performance of work under this contract shall be repaired to assure continuing facility operation and integrity, at no increase in contract cost.

1.5 PREMIUM TIME

A. Premium time shall be included in the Base Bid for electrical system(s) outages and for other work as required by the schedule, as shown on the drawings and as noted in other Divisions of the Specifications.

PART 2 - PRODUCTS

2.1 EXISTING MATERIALS

A. All materials which are a part of the building shall remain the property of the Owner.

2.2 EXISTING MATERIALS TO BE REINSTALLED

A. Existing materials and equipment (except interior, undamaged raceways) that are removed as a part of the work or stored in surplus shall not be reinstalled as a part of the new systems unless specifically noted or authorized in writing by the Owner. Forward a copy of the authorization to the Engineer. The requirements of the specifications (i.e., condition, installation, testing, etc.) shall apply as if the materials were new, furnished by the Contractor.

2.3 EXISTING MATERIALS NOT TO BE REINSTALLED

A. In coordination with the Architect, these materials shall be made available for his inspection and decision as to whether the Owner will retain possession. Items selected for retention shall be turned over to the Owner. These items shall be delivered to a location on the premises selected by the Owner. Take reasonable care to avoid damage to this material. If the Contractor fails to conform to this requirement, he shall purchase and turn over to the Owner replacement material of like kind and quantity.

B. All material not selected for retention by the Owner and debris shall be legally disposed of by the Contractor.

PART 3 - EXECUTION

3.1 EXISTING CONDITIONS

A. Examine the structure, building, and conditions under which electrical work is to be installed for conditions detrimental to proper and timely completion of electrical work. Do not proceed with work until deficiencies or detrimental conditions have been corrected. Report deficiencies or detrimental conditions of existing electrical work which might be unsuitable to connect with or receive other work. Failure to so report

shall constitute acceptance of other work as being fit and proper for the reception of electrical work.

B. Field trace all existing circuitry affected by the project to determine:

1. Source of supply or information collection point within the project area
2. Load or termination within the project area
3. Load or termination outside the project area, but supplied from or connected to equipment within the project area
4. Loads supplied from and located outside of the project area, but have circuitry within the project area.

3.2 REMOVAL

A. All removal work required under this contract is not shown on the electrical drawings. Refer to work of other divisions for contract work that may affect existing electrical systems. Coordinate work between trades prior to bid.

B. Switchboards, panelboards, signaling and communication systems, other electrical equipment free standing or surface mounted, raceway (exposed) and conductors; which are not presently in service or will not be in service as a result of this contract shall be removed.

C. Contractor shall remove all floor, wall or ceiling mounted outlet devices in the "Removal" or "Demolition Area" indicated on the drawing, even if the equipment/or device is not individually shown on the project drawings. Unused flush mounted devices, outlet and other boxes in finished areas shall be removed from wall and the remaining hole patched to match adjacent wall surfaces.

D. Unused raceways and wire shall be removed back to source if accessible, otherwise cut flush at ceiling, floor or wall and fill with grout.

E. If Contractor questions whether a particular device is to be removed notify the Architect noting type and location of device. If so directed the Contractor shall maintain the existing device in service without any change in contract price.

3.3 EXISTING SYSTEMS MAINTAINED

A. Maintain existing systems not identified for demolition. Maintaining existing systems includes relocating the systems to coordinate with work of this contract, when work of this contract cannot be done while the existing system is in its present location.

B. Any existing wiring serving devices to remain in service and which may be affected by work performed under this contract shall be rerouted to maintain circuit continuity. Contractor shall assume the risk of maintaining existing systems, except relocation of wiring of #2 AWG and above shall be considered an additional cost if not shown to be relocated. If such wiring is found the Contractor shall notify Architect Owner of wiring location, reason it must be removed and cost of relocation and receive the Owner's approval before proceeding with the work.

C. Examine drawings of all disciplines to determine where work of other trades will or is likely to require relocation of existing systems. Remove and relocate electrical

equipment in the way of work of other trades. Exact relocation requirement of existing systems to remain to be based on detailed coordination with other trades. Contractor to provide proposed locations of relocated devices to Owner for approval prior to commencement of work.

D. Relocation of any system shall be permanent.

E. Re-route existing circuits that are affected as a result of this contract that serve devices to remain in service.

1. Power Circuits (Including removal or relocation of existing panelboards).

a. Prior to demolition work trace out and identify each branch circuit and feeder circuit that serves loads in occupied areas.

b. Provide temporary wiring, schedule outage and reconnect loads to temporary wiring.

c. Provide new wiring in new location.

d. Schedule outage, disconnect temporary wiring, and connect loads to new wiring. Remove temporary wiring.

e. Outage for each circuit shall not be more than 20 minutes.

2. Signal and Communication Systems

a. Prior to demolition trace out and identify device and systems being served.

b. Provide temporary wiring to maintain operation of system throughout facility.

c. Schedule outage and connect to temporary wiring and test system.

d. Provide new wiring on new location.

e. Schedule outage, disconnect temporary wiring, and reconnect to new wiring. Remove temporary wiring.

f. Outage for each system shall not be more than 20 minutes.

3.4 TEMPORARY ELECTRICAL SYSTEMS

A. Provide temporary lighting, exit lighting, and fire notification in areas of construction that will have ongoing or intermittent public access. Temporary lighting shall comply with IES standards and other provisions of these specifications. Selected light fixtures must have battery backup to allow for egress at all times. Indicate path to nearest exit with exit signs. All temporary systems shall be removed after they are no longer in operation.

B. Removing, temporary installation, and reinstalling in ceilings of light fixtures, speakers, detectors, exit signs and other electrical equipment is not shown on the drawings. The Contractor shall investigate the ceiling demolition work and include appropriate temporary work in the bid. The sequence of work shall be (1) Remove and store fixtures, detectors and speakers along with removal of ceiling, (2) Provide temporary support for wired fixtures and devices to be reinstalled in new ceiling at approximately the same location. Use chains for lighting fixture support. (3) Clean and reinstall in the

new or replaced ceilings. Provide new lamps when so noted. Provide temporary relocation of exit signs to original location when exit is reactivated.

3.5 WORK OUTSIDE OF REMODEL AREAS

A. Provide new wiring systems in concealed ceiling spaces, unless the structure is open to the floor below.

B. For work outside of the project area assume that removal and replacement of ceiling tiles is required in all finished areas. Spaces above existing ceilings are highly congested.

C. Route wiring around obstructions and provide pull boxes per code. Carefully remove, store or temporarily hang and re-install in undamaged condition all electrical equipment, lighting fixtures and ceiling tiles where access to perform work is required. Clean prior to re-installation. Provide new lamps when so noted.

3.6 NEW DEVICES IN REMODEL AREAS

A. Provide flush mounting for devices in existing walls. Fish conduit in wall. Where existing boxes are indicated to be reused, extend box as necessary and provide new devices and plates.

END OF SECTION 26 05 10

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUBMITTALS

A. Comply with Division 01.

B. Product Data: For each type of product.

C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND 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. Alcan Products Corporation; Alcan Cable Division.
2. Alpha Wire.
3. Belden Inc.
4. Encore Wire Corporation.
5. General Cable Technologies Corporation.
6. Southwire Incorporated.

B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-THWN, Type XHHW-2 and Type SO.

2.2 CONNECTORS AND SPLICES

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. AFC Cable Systems, Inc.
2. Gardner Bender.
3. Hubbell Power Systems, Inc.
4. Ideal Industries, Inc.
5. Ilsco; a branch of Bardes Corporation.
6. NSi Industries LLC.
7. O-Z/Gedney; a brand of the EGS Electrical Group.

8. 3M; Electrical Markets Division.
9. Tyco Electronics.

B. Description: UL listed, factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

C. For #14 through #10 AWG wire sizes, provide insulated spring wire connectors or insulated compression connectors.

D. For #8 AWG wire, use solderless pressure connectors with insulating sleeves.

E. For #6 AWG and through #2, optional use split bolt connectors with manufactured insulation covers or tape sufficient to provide 150% insulation level.

F. For #6 and larger: Compression connectors using compression dies designed for the exact connector being terminated. Provide insulting sleeves manufactured specifically for the connector being used. Mechanical termination integral to overcurrent protective devices are also acceptable.

2.3 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 14 AWG and smaller; stranded for No. 12 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 14 AWG and smaller; stranded for No. 12 AWG and larger, except VFC cable, which shall be extra flexible stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders and Branch Circuits: Type THHN-THWN, single conductors in raceway.

B. Feeders and Branch Circuits Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway**.**

C. Feeders and Branch Circuits Concealed in below grade concrete walls, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

D. Feeder and Branch Circuits exposed above roofing: XHHW-2.

E. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

F. Variable Frequency Controller Output Circuits: Type XHHW-2 in metal conduit.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. 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.

C. 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.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 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.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.5 IDENTIFICATION

A. 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.

3.6 PENETRATIONS

A. Penetrate fire barriers, smoke barriers, vapor barriers, roofing materials and other rated architectural elements in a manner that preserves the rating of the architectural element.

B. 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."

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

B. Test and Inspection Reports: Prepare a written report to record the following:

1. Procedures used.

2. Results that comply with requirements.

3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 26 05 19

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 260548 - "Seismic Controls For Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Concrete bases (housekeeping pads) for electrical equipment.

1.3 REFERENCES

A. ASTM A325: American Society for Testing and Materials - Standard Specification for Structural Bolts.

B. ASTM A603: American Society for Testing and Materials - Standard Specification for Zinc-Coated Steel Structural Wire Rope.

C. IBC: International Building Code. as adopted and amended by local jurisdiction.

D. ICC: International Code Council.

E. MFMA-3: Metal Framing Manufacturers Association's Metal Framing Standards Publication.

F. NECA 1: National Electrical Contractors Association Standard Practices for Good Workmanship in Electrical Contracting.

1.4 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. RMC: Rigid metal conduit.

1.5 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for raceways, including comprehensive engineering analysis by a qualified professional engineer, registered in the same state as the project, using appropriate performance requirements and design criteria. Refer to: Section 260548 "Seismic Controls for Electrical Systems".

1. Design supports for raceways capable of supporting combined weight of supported systems and its contents plus 25% spare space capacity.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

B. 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.

1.6 SUBMITTALS

A. Shop Drawings: Show fabrication and installation details.

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.

B. Seismic Data: Signed and sealed by a qualified professional engineer and associated structural calculations. Coordinate with submittal requirements of Section 260548 "Seismic Controls for Electrical Systems".

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Allied Tube & Conduit.
    b. Cooper B-Line, Inc.; a division of Cooper Industries.
    c. ERICO International Corporation.
    d. GS Metals Corp.
    e. Thomas & Betts Corporation.
    f. Unistrut; Tyco International, Ltd.
    g. Wesanco, Inc.
2. Finishes:
    a. Plated Coatings: Zinc Plated. Fitting and accessories - zinc plated
3. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, stainless 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. 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.

5) MKT Fastening, LLC.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

5. Toggle Bolts: All-steel springhead type.

6. Hanger Rods: Threaded steel.

2.2 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 Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 SUPPORT INSTALLATION -GENERAL

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

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 50% of load..

C. 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 or use expansion anchor fasteners.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
5. To Light Steel: Sheet metal screws.
6. 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.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.2 HANGERS AND SUPPORTS FOR RACEWAYS

A. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

B. Suspended ceiling systems: Do not attach raceways to ceiling suspension system hangers.

C. Raceways 3/4" (20mm) and smaller serving equipment located within ceiling cavity or mounted on or supported by the ceiling grid system may be supported by dedicated #12 ga. galvanized, soft annealed mild steel wire hangers. Two raceways maximum per hanger. Attach raceways to wires with clips manufactured for the purpose.

D. Raceways 1" and larger: Provide lay-in pipe hangers on 1/4" (6mm) or larger all threaded rods attached to metal ceiling inserts or to structural members at not greater than spacing noted above and within 12" (300mm) of each change in direction.

E. Multiple Raceways or Cables: When more than two raceways will use the same routing, group together on a channel trapeze support system supported by threaded rods attached to metal ceiling inserts or structural members. Size supports for multiple raceways for 25% future capacity. Trapeze shall be sized in accordance with SMACNA Guidelines with conduit weight taken to be as listed for same size pipe filled of water.

1. Secure raceways and cables to these supports with single-bolt conduit clamps.

3.3 SUPPORT FOR LIGHT FIXTURES

A. Provide support system designed by registered engineer for all light fixtures over 50 pounds.

B. Surface outlet boxes, to which fixtures are attached, and pull boxes shall be fastened to the structure independent of the conduit support system.

C. Conduits shall not be supported by a ceiling suspension system.

D. Recessed mounted type fixtures less than 20 pounds installed in lay-in ceiling: Provide four support clips, Caddy #515 or similar, (one each corner) which lock light fixture to ceiling tees after light fixture is installed. The long dimension of the fixture shall be installed so that it is supported on the main support member of the ceiling system. In addition, provide for each light fixture two #14 earthquake chains or #12 wires secured located at diagonally opposite fixture corners and attached to structural members above suspended ceiling.

E. Recessed mounted type fixtures less than 50 pounds installed in lay-in ceiling: Provide four support clips, Caddy #515 or similar, (one each corner) which lock light fixture to ceiling tees after light fixture is installed. The long dimension of the fixture shall be installed so that it is supported on the main support member of the ceiling system. In addition, provide for each light fixture four #14 earthquake chains or #12 wires (one in each corner) installed taut and secured to structural members above suspended ceiling.

F. Recessed mounted type fixtures installed in plaster or gypsum ceiling. Provide support chains or wires similar to lay-in ceiling requirements except also provide plaster frame compatible with light fixture. Attach support wires/chains to plaster frame.

G. Surface mounted type fixtures less than 50 pounds installed on suspended ceilings: Provide metal carrying channels above suspended ceiling spanning between ceiling support channels supported with minimum 3/8” threaded rod from the structure above. Attached fixture through ceiling to carrying channels. In addition, provide for each light fixture four #14 earthquake chains or #12 wires installed taut from metal carrying channels to structural members above suspended ceiling.

H. Surface mounted type fixtures less than 20 pounds installed on suspended ceilings: Provide support frame above suspended ceiling supported with minimum 3/8” threaded rod from the structure above. Attached fixture through ceiling to support frame. In addition, provide for each light fixture two #14 earthquake chains or #12 wires secured located at diagonally opposite fixture corners of plaster frame secured to structural members above suspended ceiling.

I. Surface mounted type fixtures less than 50 pounds designed to be supported from fixture junction box:

1. Provide hanger bars between structural members. Attach junction box directly to hanger bars.

2. Attach heavy formed steel straps to the outlet box by means of threaded stems with locknuts, or directly to the outlet box where the light fixture is specifically so designed. Support junction box from structure with 1/4" threaded rod.

J. Pendant mounted type fixtures less than 50 pounds:

1. For fixtures with rigid pendants, provide swivel ball aligners at canopy.

2. Where mounted below suspended ceiling, support fixture from structural members above ceiling by means of minimum 3/8" threaded stems with locknuts.

3.4 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "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.

3.5 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) 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 (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03.

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.

3.6 COATINGS

A. Touchup: Clean field cuts, field welds and abraded areas of PVC, Epoxy and Acrylic coated products. Re-coat exposed areas immediately after erecting hangers and supports. Follow manufacturer's instructions for repair of coated products.

B. Hot Dip Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. AASHTO American Association of State Highway and Transportation Officials

B. EMT: Electrical metallic tubing.

C. FMC: Flexible metal conduit

D. GRC: Galvanized rigid steel conduit.

E. LFMC: Liquid tight flexible metal conduit.

F. RNC: Rigid nonmetallic conduit.

PART 2 - PRODUCTS

2.1 GENERAL

A. Listing and Labeling: Products shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70 requirements.

C. Minimum Raceway Size: 3/4-inch trade size.

2.2 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Company.
6. Eaton
7. Maverick Tube Corporation.
8. O-Z/Gedney – Emerson
9. Western Tube and Conduit Corporation.
10. Wheatland Tube Company; a division of John Maneely Company.

B. Conduit

1. GRC: Comply with ANSI C80.1 and UL 6. Hot dipped zinc galvanized.
2. FMC: Comply with UL 1; zinc-coated steel or aluminum.
3. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
4. Fittings: Comply with NEMA FB 1 and UL 514B.
   a. Material: Match conduit material.
   b. Type: Threaded, compression or split.
5. Joint Compound: Approved, as defined in NFPA 70, 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.

C. EMT: Comply with ANSI C80.3 and UL 797.
   1. Couplings: Setscrew or compression. Steel. May be constructed integral with tubing.
   2. Indentor, Tap On, and Die Cast fittings are not acceptable.

D. Deflection/Expansion Fittings: Comply with UL 651, rated for environmental conditions where installed, and including flexible internal or external bonding jumper.

2.3 NONMETALLIC CONDUIT AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
   1. AFC Cable Systems, Inc.
   2. Anamet Electrical, Inc.
   3. Arnco Corporation.
   4. Carlon
   5. CANTEX Inc.
   6. CertainTeed Corp.
   7. Condux International, Inc.
   8. ElecSYS, Inc.
   9. Electri-Flex Company.
   10. Lamson & Sessions; Carlon Electrical Products.
   11. Manhattan/CDT/Cole-Flex.
   12. RACO; a Hubbell company.
   13. Thomas & Betts Corporation.

B. RNC
   1. Complying with NEMA TC 2 and UL 651. Type EPC-40-PVC and Type EPC-80-PVC.
   2. Fittings: Comply with NEMA TC 3; match to conduit or tubing type and material. Couplings may be constructed integral to raceway.

2.4 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following

1. Eaton-Cooper B-Line, Inc.
2. Hoffman; a Pentair company.
3. Husky
4. Schneider Electric.

B. Construction:

1. Sheet metal: sized and shaped as indicated,
2. Indoors: NEMA 250, Type 1, hinged cover.
3. Outdoors and unheated spaces: NEMA 250 Type 3R, Flanged and gasketed cover.
4. Stainless steel Type 4X in kitchens, sterilization rooms, laundry, washdown, and similar environments. Flanged and gasketed cover.

C. Fittings and Accessories: Include 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. Finish: Manufacturer's standard enamel finish.

2.5 BOXES, CABINETS, ENCLOSURES

A. Suitable and listed for the environment in which they are installed per UL 50 and NEMA 250.

1. Indoors: NEMA 250, Type 1.
2. Outdoors: NEMA 250 Type 3R, Flanged and gasketed cover.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following

1. Eaton.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Pentair - Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co; Adalet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).

13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

C. Sheet Steel Gage (Any Direction)

1. Less than 24": 14 USS gauge.
2. Greater than 24": 12 USS gauge.

D. Outlet and Device Boxes

1. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
2. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, galvanized ferrous alloy for use with IMC and RMC, aluminum for use with ARC, Type FD.
3. 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.
4. Wall Device Box Dimensions: Minimum depth 2-1/8 inches. Gangable boxes are permitted.
5. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

E. Pull and Junction Boxes

1. Small Sheet: NEMA OS 1.
2. Cast-Metal: Comply with NEMA FB 1 and UL 1773, galvanized cast iron with gasketed cover.
3. Access Cover as follows, unless otherwise indicated:
   a. Screw Cover:
      1) Both cover dimensions less than 30 inches
      2) In line pulls with one cover dimension less than 16 inches
   b. Either cover dimension greater than 30 inches: One or more hinged cover(s) with Latch.

F. Cabinets and Enclosures

1. Finished inside and out with manufacturer's standard enamel.
2. Access Door:
   a. Hinged with key latch to match panelboards.
   b. Three point latch when dual doors are in use or when hinged side exceeds 47 inches.
   c. Gasketed
3. Metal barriers to separate wiring of different systems and voltage.
4. Labeled with appropriate safety warnings
5. Accessory feet where required for freestanding equipment.
6. Interior Panels: Steel; all sides finished with manufacturer's standard enamel. Removeable. Hardware and accessories suitable for supporting equipment.

7. Provisions for seismic anchoring and deflection per Section 260548 Seismic Controls for Electrical Systems.
8. Lugs for grounding conductor(s) bonded to enclosure.
9. Accessories:
    a. Door Pocket for wiring diagram

2.6 PENETRATIONS

A. Sleeves and seals associated with penetrations shall preserve the fire, thermal, water, or other rating of the penetrated element. Refer to Division 7 for Penetration Firestopping products.

B. 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.

C. Compressive Seals:
1. Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Eaton/Crouse Hinds Link Seal.
    b. Emerson/OZ Gedney
3. Sleeve or body casting: Cast iron, cast in place or core drill.
4. Sealing Elements EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
5. Pressure Plates: Glass Reinforced Nylon or PVC coated stainless steel
6. Connecting Bolts and Nuts: 316 type Stainless steel of length required to secure pressure plates to sealing elements.
7. Completed assembly suitable rated at 20 psig or 40 feet of head.

D. Raceway Seal Fittings
1. General
    a. For use with GRC. Sealant fill, wire fill provisions and orientation to match application, location and containment requirement.
    b. Sealing system, may be removed for replacement of wire without affecting integrity of raceway system.
    c. Sealant or sealing material furnished by fitting manufacturer to match application and be compatible with wire insulation type and thermal rating.
2. Foam Sealant: High expansion, two part urethane foam, 120 lb compressive strength and capable of withholding 22 feet of water head pressure. Complies with UL 94 fire rating HBF. American Polywater FST or equal.

3. Sealing Bushings: Slotted PVC coated steel discs; neoprene sealing ring; stainless steel socket head cap screws and washers. Custom holes drilled to accommodate cables. Stainless steel socket head screws. Hot dipped galvanized malleable or ductile iron locking collars. Seals against gas or fluid pressure of 50 psig. O-Z Gedney CSB series.
4. In Line Epoxy Cement Fill Fittings: For control of gasses and vapors, rated for 40% fill, liquid epoxy sealant, Emerson EY or EYAX series or equal.
5. Comply with UL 1203 for explosion proof and dust ignition proof environments.

PART 3 - EXECUTION

3.1 GENERAL

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.

B. Comply with NFPA 70.

C. Comply with requirements in Division 26 Sections "Hangers and Supports for Electrical Systems" and “Seismic Controls for Electrical Systems” for hangers and supports.

D. Determine optimal raceway routes that result in coordination with all building systems. Determine pull box quantities, sizes and locations.

3.2 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC with threaded couplings.
2. Concealed Conduit, Aboveground: GRC with threaded couplings.
3. Boxes and Enclosures, Aboveground: NEMA 250, Type 4X

B. Indoors:
1. Exposed, Not Subject to Physical Damage: EMT
2. Exposed and Subject to Damage: GRC with threaded couplings
   a. Raceway locations include the following (any height):
      1) Loading dock.
      2) Gymnasiums
   b. Raceway locations include the following, when below 8 feet above floor:
      1) Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
4. Damp or Wet Locations: GRC with threaded couplings.
5. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4X stainless steel in institutional and commercial kitchens, trash compactor areas, at sump pumps, and similar damp, wet or corrosive locations.

C. In Slabs: Not permitted.

D. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

E. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

2. EMT: Use compression or setscrew fittings. Comply with NEMA FB 2.10. Cast metal fittings are not acceptable

3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

3.3 INSTALLATION

A. Install raceways parallel or perpendicular to structural building lines. Conceal conduit and EMT within finished walls, ceilings, and floors except as follows:

1. In rooms without a dropped ceiling.

2. In non-public spaces such as mechanical, electrical, communication rooms.

3. Unless otherwise indicated.

B. Do not route:

1. Parallel horizontal runs of raceways within 6 inches (150 mm) or directly above flues, steam, or hot-water piping.

2. Nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C)

3. Aluminum conduits or fittings in contact with concrete or earth.

C. Complete raceway installation before starting conductor installation.

D. Anchors and Supports:

1. Positively attach raceways, boxes, and enclosures to structure, do not attach to supports for mechanical or other non-electrical systems.

2. Support raceways within 12 inches (300 mm) of enclosures to which attached.

3. Set boxes, enclosures, and cabinets plumb.

E. Raceway Terminations:

1. 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.

2. Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors.

3. 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.

4. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

5. 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.

6. 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.

F. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap, plug or compressive seal underground raceways designated as spare at point of below grade entry into building or at first pulling access point.

G. Stub-ups:

1. Above Recessed Ceilings: Use a raceway bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

2. Through slab, comply with either:

a. Arrange stub-ups so curved portions of bends are not visible above finished slab.

b. Terminate conduit at threaded GRC coupling with top of coupling 1/8” below top of slab.

H. Outlet and Device Boxes:

1. Mount outlet boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install wall outlet boxes with height measured to center of box unless otherwise indicated.

2. 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 rain-tight connection between box and cover plate or supported equipment and box.

3. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel. Do not compromise wall ratings for fire and sound separation.

4. Locate boxes so that cover or plate will not span different building finishes.

5. 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.

6. Box construction and size to match device requirements. Where device is furnished under this or other Divisions of this specification obtain requirements prior to roughing in.

7. Set floor boxes level and adjust to match finished floor surface.

8. Provide cast outlet boxes in exterior, wet, or cast in concrete locations.

I. Movement:

1. General

a. Select raceway elements to accommodate the expected movement. Set initial position of raceway movement element as appropriate to accommodate ultimate worst case movement.

b. Install raceway supports to allow for expansion movement.

c. Provide bonding jumper for fittings without a continuous ground path.

2. Raceway thermal performance:

a. Install in each run of aboveground metallic raceway 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).

b. 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.

3. Structural and Architectural Elements: Install expansion fittings or flexible raceways at all locations where raceways cross building or structure expansion joints. 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.

4. Where piston fittings are used provide slack conductor in adjacent pull boxes or equipment to alleviate stress on conductor terminations during expansion joint movement.

J. 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, transformers and motors.

3.4 SEALS

A. Select seals as appropriate for the element (ie: liquids, gasses, dust, and/or vapor) the seal is isolating.

B. Follow manufacturer’s instructions when installing sealants and seal fittings.

C. Location:

1. Seal fitting shall be accessible.

2. Locate seal fittings so no fittings or boxes are between the seal and the element requiring isolation.

3. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish like that of adjacent plates or surfaces.

D. Transition to RMC where required by code or seal fitting application.

E. Seal the following points:

1. Where raceways pass from warm to cold locations:

a. Boundaries of refrigerated spaces

b. Boundaries between heated and unheated spaces.

2. Raceway connections to continually wet environments such as sumps and wells.

3. To limit transmittance of hazardous liquids, gasses, dust, and/or vapors.

4. Where raceways 2” and larger rise from below grade to terminate at stand or slab mounted exterior utilization equipment.

3.5 PENETRATIONS

A. Penetrate fire barriers, smoke barriers, vapor barriers, acoustic barriers, waterproofing, roofing materials, floors, walls, foundations, and other rated architectural and structural elements and assemblies in a manner that preserves the integrity of the rating and the intended performance.

1. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07 requirements for penetration firestopping.

2. Roof penetrations shall be made in accordance with the recommendations of the roofing system supplier and shall not compromise the roofing warranty.

B. Penetration of below grade walls and slab on grade:

1. Comply with either of the following:

a. Cast raceways into wall or slab.

b. Provide sleeve and compression seal between sleeve and raceway. The compression seal manufacturer shall have documentation indicating that the sleeve is compatible with the seal.

2. Seal interior of raceways:

a. Seal Bushings: Utilize at all penetrations where other seals are not specified. Provide a pull box for sealing bushing(s) at point of entry when end use equipment is located away from wall or elevated above slab.

b. Foam Sealant:

1) For phase conductor sizes #2 AWG and smaller.

2) For feeder (not service) phase conductor sizes larger than #2AWG, where no portion of the raceway entering the building or equipment travels below grade at a height that is above the point of entry or the point of raceway termination at the equipment

3) Apply foam sealant at raceway entry point into first interior and exterior pull point.

4) Apply foam sealant at all raceways entering handholes and manholes.

c. Below slab raceways are not required to be sealed when the following conditions are met:

a) The raceway travels below slab from one interior building point to another, and the slab entrance and exit points are at same height.

b) The raceway horizontal travel distance is less than 20 feet or the raceway is less than 2” in diameter and the horizontal travel distance is less than 100 feet.

3.6 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 26 05 33

SECTION 26 05 48 - SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED SECTIONS

A. Section 260529 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

B. Refer to Product specification paragraphs of individual Division 26 Sections

1.3 SUBMITTALS

A. Product Data: For each type of product.

1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
    a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by any of the following:
        1) an evaluation service member of ICC-ES
        2) California OSHPD
        3) an agency acceptable to authorities having jurisdiction.
    b. Annotate to indicate application of each product submitted and compliance with requirements.
2. Coordinate submittal information with Section 260529 "Hangers and Supports for Electrical Systems" and organize the submittals of that section and this section making it clear which products will be associated with systems requiring seismic restraint.

B. Delegated-Design Submittal: For support and anchoring of electrical products.

1. Engineer of Record: Professional Structural Engineer with appropriate seismic certification shall provide design calculations and details for seismic restraints complying with performance requirements and design criteria described herein and as established by the authority having jurisdiction. Submit detailed designs of equipment support, anchoring and mounting with associated design calculations signed and sealed by the qualified professional engineer responsible for their preparation.
    a. Submittal review by the Engineer of Record for Division 26 will not include a review of structural engineering.
    b. Submit documentation as requested by the authority having jurisdiction to the authority having jurisdiction, obtain approval and comply with all review comments.

2. Comply with ASCE/SEI 7 requirements for non-structural components and submit the following items. Format shall be suitable for acceptance by the authority having jurisdiction.

    a. Component seismic qualifications and special certifications. Refer to specification sections for additional requirements.

    b. Design calculations accounting for seismic demand on non-structural components.

    c. Details of component anchoring for each of the products in the Division 26 specification sections, unless exempted by ASCE 7. Details shall demonstrate attachment compatibility with building structure and equipment.

    d. Details of component supports and seismic restraints for each of the products in the Division 26 specification sections, unless exempted by ASCE 7. Details shall demonstrate attachment compatibility with building structure and equipment.

    e. Details allowing for seismic movement:

        1) Flexible raceway and cabling connections to the top of switchboards, and other floor mounted equipment which is anchored at its base as a free cantilever and/or supports restraining free cantilever movement.

        2) Raceways and cabling transitioning across multiple floors or across expansion joints. Determine floor to floor movement from building structural engineer.

        3) Service entrances to building where soil movement is expected between the building and soil supported systems.

        4) Where raceways connect to components mounted on seismic isolation systems.

3. Seismic Restraint Details:

    a. As appropriate to the product item, seismic restraints include anchors, supports, bracing, isolation or other means to force the product to withstand the seismic performance criteria and to not adversely affect itself or other systems with the limits of movement established by the design.

    b. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.

    c. 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. Cross reference seismic restraint and supporting elements to tabulated product data.

C. Coordination Drawings: Show coordination of seismic restraint for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints. Electrical components include:

1. Non-seismically restrained systems that may affect seismically restrained systems

2. Raceways

3. Control and monitoring panels
4. Panelboards.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical products in Divisions 26 and as reference by other Divisions to this Section; their associated product supports, attachments, anchors, braces, seismic restraints; and integrated assemblies thereof; shall be designed and constructed per the performance requirements specified herein.

B. Seismic Criteria:

1. Refer to the International Building Code (IBC) as adopted and amended by the local authority having jurisdiction the project site to determine seismic force criteria. Refer to ASCE 7 for seismic design requirements for nonstructural components.
2. Refer to the Structural Drawings for the earthquake design data required by IBC 1603.1.5 applicable to the project site and building.
3. Determine seismic criteria applicable to equipment at specific locations within the building, for example: ground floor versus roof top seismic acceleration.

C. Electrical products shall have an ASCE/SEI 7 Component Importance Factor, Ip, assigned as follows:

1. As specified in individual sections of the product specifications for special certifications per ASCE/SEI 7 paragraph 13.2.2.
2. An Ip of 1.5 is assigned to Emergency and Life Safety System products and connecting wire and raceway. Refer to drawings for emergency and life safety system components which include, but not limited to:
    a. Panelboards, transformers, and other active electrical equipment supporting loads per Articles 700 and 701 of the NEC.
    b. Egress and Exit Lighting
    c. Fire Alarm System Control and Notification Panels
3. As a matter of economic investment. and not life safety, an Ip of 1.5 is assigned to the following products:
    a. Transformers rated above 40kVA
4. Unless building code requirements determine otherwise, the Component Importance Factor of electrical systems not defined above is 1.0.

D. Building Interface: Review building architectural, structural, and mechanical systems and design and construct non-compromising means of attachment and anchoring.

E. Seismic restraint products shall be approved for the application by an evaluation service member of ICC-ES. Seismic-restraint devices shall have horizontal and vertical load testing and analysis.

2.2 SPECIAL CERTIFICATIONS

A. Provide special certifications per ASCE/SEI 7 paragraph 13.2.2 for electrical products(components) with an Ip greater than 1.0 when located in Seismic Design Categories C through F. Testing shall be in accordance with the following:

1. ICC ES 156 Seismic Certification By Shake Table Testing of Non-Structural Components.

2. A current listing on the State of California's OSHPD Special Seismic Certification Preapproval list with an S_{DS} value adequate for the project site may be used to demonstrate compliance with these criteria.

B. Product certifications may be made by certifying products to levels that exceed the Performance Requirements.

2.3 RESTRAINT CHANNEL BRACINGS

A. 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, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.4 RESTRAINT CABLES

A. Restraint Cables: ASTM A 603 galvanized-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.

2.5 SEISMIC-RESTRAINT ACCESSORIES

A. Hanger-Rod Stiffener: Steel tube, angle, or steel slotted-support-system sleeve clamped or bolted to hanger rod.

B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings or restraint cables.

C. 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.

D. 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.

E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.6 ADHESIVE ANCHOR BOLTS

A. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Anchor, support, and restrain electrical products in accordance with the delegated design details required by this specification section.

B. Strength of Support and Seismic-Restraint Assemblies: Select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 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 3.

B. Equipment and Hanger Restraints:

1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).

2. Install seismic-restraint devices using methods determined by the delegated design submittal of this specification section.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. 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.

E. Attachment to Structure: Anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

F. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

1. Flexible connection shall allow for worst case movement between the independently supported elements.
2. Initial positons of the flexible or sliding element shall be based on initial position of structure relevant to movement in any direction.

B. Sliding or compression/expansion raceway elements shall have adjacent pull boxes to allow for ingress or pay out of cable/wire associated with movement of the element.

END OF SECTION 26 05 48

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment identification nameplates.
2. Identification for conductors
3. Identification for raceways
4. Warning labels and signs.
5. Receptacle Identification Labels
6. Miscellaneous identification products.

1.3 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI A13.1 "Scheme for Identification of Piping Systems"

B. Occupational Safety and Health Administration (OSHA). 29 CFR - Labor Chapter XVII Part 1910-145 "Occupational and Safety Health Standards" 1992.

1.4 ACTION SUBMITTALS

A. Product data: For each electrical identification product indicated.

1.5 QUALITY ASSURANCE

A. Comply with ANSI A13.1

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.6 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. Note that equipment names and room numbers shown on the Contract Drawings may not be final names and numbers. Confirm all final naming prior to label manufacture.

C. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

D. Coordinate installation of identifying devices with location of access panels and doors.

E. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT NAMEPLATES

A. Materials:

1. Engraved plastic laminate - three-layer laminated plastic with punched or drilled holes for screw mounting

B. Dimension

1. Nameplate minimum of 1 3/4" high by 5" wide.
2. Lettering height for panel or equipment identifier @ 1/4".
3. Lettering height for remaining lines @ 1/8" high with 1/8" spacing between lines.
4. Normal System: White letters on Black background.
5. Emergency/Standby System: White letters on Red background.
6. Comply with ANSI 13.1.

C. Panelboard Nameplates

1. Provide engraved plastic nameplate for each new panelboard with the following information:

   Line 1: Panelboard Name

   Line 2: Source from which panel is fed (e.g.Fed From SWBD 4N2A)

   Line 4: Amps, voltage, phase and wire

D. Disconnects, Starters, Combination Starters and Other Devices

1. Provide phenolic nameplate for each device with the following information:

   Line 1: Load served

   Line 2: Panelboard and circuit number from which device is fed

   Line 3: Fuse size or breaker size as applicable

2.2 CONDUCTOR AND CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each conductor and cable size.

B. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

2.3 RACEWAY IDENTIFICATION MATERIALS

A. Color for Raceways Carrying Wiring for Emergency Systems:

1. All system junction boxes and covers shall be painted yellow..

2.4 POSTED DRAWINGS

A. Electrical One-line or Risers: Print electrical one-line/riser diagrams on 20 lb. bond paper. (Blue print paper is not acceptable). Reduce drawings to approximately 1/2 size using Xerox reduction process.

B. Mounting Frames: Extruded aluminum, 4 point screw mount with 1/8" clear plexi-glass cover.

2.5 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.

2. 1/4-inch (6.4-mm) grommets in corners for mounting.

3. Nominal size, 10 by 14 inches (250 by 360 mm).

D. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2.6 RECEPTACLE IDENTIFICATION LABELS

A. Materials (Where engraved device faceplates are not used)

1. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black on clear media, by thermal transfer or equivalent process. Overlay shall provide a weatherproof and UV-resistant seal for label.

B. Identification

1. Label emergency receptacle device plates with the panelboard and circuit number supplying them below the receptacle. Label lettering shall be approximately 3/16" high, black filled characters.

2. Label normal receptacle device plates with the panelboard and circuit number supplying them below the receptacle. Label lettering shall be approximately 3/16" high, black filled characters.

3. For all receptacles other than 15 and 20 amp, 120 volts, provide separate nameplate with ampere rating, voltage and phase.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select 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

3.1 INSTALLATION - GENERAL

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

3.2 EQUIPMENT IDENTIFICATION:

A. On each unit of equipment, install unique designation nameplate that is consistent with naming used in wiring diagrams, schedules, and the Operation and Maintenance Manual.

B. In addition to equipment listed in Part 2 provide nameplates for:

1. Access doors for concealed electrical devices
2. Enclosed over-current protective devices
3. Electrical cabinets, enclosures and terminal cabinets
4. Contactors
5. Monitoring and control panels and equipment

C. Confirm all final naming prior to label manufacture.

D. Labeling Instructions:

1. Outdoor Equipment: Engraved, laminated acrylic or melamine label with screw fasteners
2. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
3. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

3.3 CIRCUIT CONDUCTOR IDENTIFICATION

A. Power-Circuit Conductor Identification, 600 V or Less:

1. For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

2. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.
   a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
   b. Colors for 208/120-V Circuits:
      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.
      4) Neutral: White
      5) Equipment Ground: Green
   c. Colors for 480/277-V Circuits:
      1) Phase A: Brown.
      2) Phase B: Orange.
      3) Phase C: Yellow.
      4) Neutral: Gray
      5) Equipment Ground: Green

3. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

4. Label neutral conductors at termination in panels with circuit number.

5. Conductors to Be Extended in the Future: Attach self adhesive label to conductors and list source.

B. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

3.4 POSTED DRAWINGS

A. Mount drawings on the wall immediately adjacent to the main piece of equipment. If sufficient wall space is available, mount directly to one of the sheet metal panels of the equipment.

B. Color Coding Sign: Install instructional sign for the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

3.5 WARNING SIGNS

A. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Apply to exterior of door, cover, or other access.
3. 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.

END OF SECTION 26 05 53

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

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.

B. Related Sections include the following:

1. Section 260519 Low Voltage Electrical Power Conductors and Cables
2. Section 265100 Interior Lighting

1.2 SUMMARY

A. This Section includes the following lighting control devices:

1. Snap switches and wall box dimmers
2. Indoor occupancy sensors
3. Outdoor photocell switches
4. Control Relays

B. This Section includes the following daylighting control devices:

1. Dimmed control (0-10V) of electronic dimming drivers with photo sensor(s).

1.3 DEFINITIONS

A. LED: Light-Emitting Diode

B. DT: Dual Technology

1.4 SUBMITTALS

A. Comply with Division 01.

B. In addition to Division 01, provide clearly marked and legible data sheets for each item of equipment being installed on the project. This shall include each major replaceable component that is part of a larger assembly. Data sheets should clearly indicate:

1. Equipment manufacturer, make, model number, size, nameplate data, etc.
2. Dimensional and performance data for specific unit provided as appropriate
3. Required environmental operating parameters
4. UL, FM and ETL listing and category
5. Manufacturer contact information including address, telephone number, facsimile number, email address, web site address and contact person or persons.
6. Local manufacturer’s representative contact information including address, telephone number, facsimile number, email address, web site address and contact person or persons.

C. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Lighting plan showing location, orientation, and coverage area of each sensor. This plan shall take into consideration the size and use of each space as well as the specific capabilities of submitted manufacturer's equipment to provide proper coverage to the areas of control.
2. Interconnection diagrams showing field-installed wiring.

D. Label List: Submit list of proposed text for all labels prior to manufacturing for review and approval by Owner's representative.

E. Warranty: Submit a copy of product warranty that complies with contract document requirements. Where these requirements exceed manufacturer's standard warranty include cost of extended warranty in contract price.

F. Maintenance Requirements: Submit maintenance requirements manual or guidelines. This document should detail the requirements necessary to comply with the warranty. This is required for the submittal process and is in addition to the O&M requirements.

G. Commissioning Checklist: Submit a copy of the proposed commissioning checklist to be utilized for this project.

H. Commissioning Results: Submit a copy of the completed commissioning documents.

1.5 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.6 QUALITY ASSURANCE

A. Qualifications

1. Manufacturer shall have been in the business of manufacturing and providing service for lighting control equipment for similar capabilities and size, under the same name and ownership, for a minimum of three years preceding bid date of the project.
2. All components and assemblies shall be factory pre-tested prior to installation.
3. Factory trained technicians shall be on site for start-up, commissioning and training.
4. Factory trained technicians shall be available for telephone support twenty four (24) hours a day, seven (7) days a week.

B. Regulatory Requirements

1. Underwriters Laboratories: Provide U.L. listed lighting control equipment.
2. Code of Federal Regulations: 47 CFR - FCC All assemblies are to be in compliance with FCC emissions standards specified in Part 15 for Class A application.

1.7 WARRANTY

A. Manufacturer's Warranty: The manufacturer shall provide a written warranty agreeing to provide parts to replace any portion of the lighting control system equipment that fails due to material or workmanship for a period of twelve months from warranty commencement.

B. Warranty Commencement: Warranty shall begin at the point of substantial completion of the system installation, which is defined as the date when commissioning and owner training has been completed and the owner obtains beneficial use of the system.

C. Warranty Replacement Parts: The manufacturer shall be able to ship replacement parts within 24 hours for any component that that fails due to material or workmanship during the warranty period.

PART 2 - PRODUCTS

2.1 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Single Pole:
      1) Cooper; AH1221.
      2) Hubbell; HBL1221.
      3) Leviton; 1221-2.
      4) Pass & Seymour; CSB20AC1.
   b. Three Way:
      1) Cooper; AH1223.
      2) Hubbell; HBL1223.
      3) Leviton; 1223-2.
      4) Pass & Seymour; CSB20AC3.
   c. Four Way:
      1) Cooper; AH1224.
      2) Hubbell; HBL1224.
      3) Leviton; 1224-2.
      4) Pass & Seymour; CSB20AC4.

C. Pilot-Light Switches, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper; AH1221PL for 120 and 277 V.
   b. Hubbell; HBL1201PL for 120 and 277 V.

c. Leviton; 1221-LH1.

d. Pass & Seymour; PS20AC1RPL for 120 V, PS20AC1RPL7 for 277 V.

2. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."

D. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 1995.

b. Hubbell; HBL1557.

c. Leviton; 1257.

d. Pass & Seymour; 1251.

2.2 WALL-BOX DIMMERS

A. Subject to compliance with the contract documents, provide products from one of the following manufacturers:

1. Lutron
2. Leviton
3. Wattstopper

B. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

C. Control: Continuously adjustable slider with single-pole or three-way switching. Comply with UL 1472.

D. Where two or more devices are ganged together, a single faceplate without visible fasteners will cover all devices.

E. LED Lamp Dimmer Switches: Modular; compatible with dimmer drivers; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.3 INDOOR OCCUPANCY SENSORS

A. Subject to compliance with the contract documents, provide products from one of the following manufacturers:

1. Cooper Industries, Inc.
2. Hubbell Building Automation, Inc.
3. Leviton Mfg. Company Inc.
4. Acuity Lighting Group, Inc.
5. Lutron Electronics Co., Inc.
6. Sensor Switch, Inc.
7. Watt Stopper.

B. General Operation

1. The Occupancy Sensor system shall sense the presence of human activity within the desired space and fully control the on/off function of the loads automatically. Sensors shall turn on the load within 2 feet of entrance and shall not initiate "on" outside of entrance.

2. Upon detection of human activity by the detector, a Time Delay shall be initiated to maintain the light on for a field adjustable pre-set period.

3. Mounting

   a. Sensor: Suitable for mounting in any position on a standard outlet box.

   b. Relay (when required): Externally mounted through a 1/2 inch knockout in a standard electrical enclosure or integral to the sensor.

   c. Time Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

4. Line Voltage Sensors

   a. Sensor shall be a self-contained dual voltage device capable of directly switching loads upon detection of human activity.

   b. Sensor must be rated for 800 watts at 120 VAC, suitable for incandescent light fixtures, fluorescent light fixtures with electronic ballasts, or 1/6 hp motors or rated for 1000 watts at 277 VAC, suitable for LED light fixtures with electronic drivers, or 1/3 hp motors minimum. Sensor shall be capable of parallel wiring for 3-way switching applications.

   c. Sensor Time Delay shall be factory set for typical applications, and field adjusted during commissioning. Sensor must provide a LED motion indicator.

5. Low Voltage Sensor

   a. Sensors must be designed to work in conjunction with remote power packs, relays, or other control systems. Sensors must operate with a Class 2, low voltage wiring strategy. Sensors must be capable of being parallel wired for multi-sensor applications.

   b. Sensor must provide a transistor output, returning the voltage input rectified to DC, to control remote power packs, relays, or other control systems. Sensor must be available with an optional single pole, double throw signal relay capable of being wired open on occupancy, or closed on occupancy. Sensor Time Delay shall be factory set for typical applications, and field adjusted during commissioning. Sensor must provide a LED motion indicator.

C. Switch-Box Occupancy Sensors

1. General

   a. Sensor must not protrude out from the cover plate more than 0.37 inches, and recess into the switch box more than 1 inch. Sensor must surface mount to single gang switch box, and accept accessory plates for multi-

gang installations. Sensor must provide an Off/Auto override switch, (2 switches if 2-pole device).

b. Optional 2-Pole units must be available. Manual or Auto ON shall be configurable for both poles.

c. Passive Infrared (PIR) Technology

d. PIR sensing, incorporating a combination of heat and movement sensing to detect occupancy in the area of coverage.

2. Switch Type:

a. Single pole

b. Single pole, dual circuit.

c. Single pole, field selectable automatic "on," or manual "on" automatic "off."

d. Single pole, dual circuit, field selectable automatic "on," or manual "on" automatic "off."

3. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.

D. Ceiling Occupancy Sensors

E. General

a. Sensor shall be ceiling mounted device, mounted to either a single gang enclosure, or surface mounted to a round surface raceway pancake box.

b. Time delay shall be set during commissioning and field adjustable.

c. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.

d. Bypass Switch: Override the "on" function in case of sensor failure.

e. Ambient-Light Override: Where indicated on drawings provide concealed, field-adjustable, light-level sensor from 2 to 200 fc (21.5 to 2152 lux). The switch shall prevent the lights from turning on when the light level is higher than the set point of the sensor.

f. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).

g. Detection Coverage

1) Small Room: Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

2) Standard Room: Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

3) Large Room: Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

4) Corridor: Detect occupancy anywhere within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 14 feet (4.3 m).

h. Dual Technology (DT)

i. Sensing must incorporate PIR with Ultrasonic. Both PIR and Ultrasonic motion sensing shall initiate an ON condition and either technology sending motion shall keep the ON state.

2.4 POWER PACKS AND SLAVE PACKS

A. Manufacturer:

1. Cooper Industries, Inc.
2. Hubbell Building Automation, Inc.
3. Leviton Mfg. Company Inc.
4. Acuity Lighting Group, Inc.
5. Lutron Electronics Co., Inc.
6. Sensor Switch, Inc.
7. Watt Stopper.

B. Power Packs and Slave Packs must be designed to power and accept signals from remote Low Voltage Sensors, or other control devices, and directly switch the line voltage of the desired load controlled.

C. Power Packs must accept 120, 240, or 277 VAC utilizing a dual tap transformer.

D. Power Pack and Slave Pack relay switching shall not require more than 3 milliamps of current at 15 to 30 VDC.

E. Power Pack and Slave Pack relay switching shall be performed with a mechanical relay in parallel with an AC Semiconductor to allow relay contacts to switch under a no load condition. Switching capacity shall be 20 amps of all types of loads: Incandescent, Electronic Ballast, Magnetic, or Motor.

F. Power Packs shall be available in combination 2-Pole units capable of switching two independent loads, 20 amps each.

2.5 DAYLIGHT-HARVESTING DIMMING CONTROLS

A. Manufacturer: Subject to compliance with the contract documents, provide products from one of the following manufacturers:

1. Greengate (Cooper Controls)
2. Leviton
3. Lutron
4. SensorSwitch

5. Wattstopper
6. Hubbell Building Automation, Inc.
7. Acuity Lighting Group, Inc.

B. System Description: Sensing daylight and electrical lighting levels, the system shall adjust the indoor electrical lighting levels. As daylight increases, the lights shall be dimmed.

1. Lighting control set point is based on two lighting conditions:
   a. When no daylight is present (target level).
   b. When significant daylight is present.
2. Provide system programming with two hand-held, remote-control tools.
   a. Initial setup tool.
   b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.

C. Photo sensors shall provide an ON set point and a separate OFF set point, thereby creating a dead band to prevent unnecessary cycling of the electric lights. Set point setting shall be verified with a digital volt meter connected to test leads provided by the sensor. Sensor shall send an electronic, low voltage signal to a remote power pack or other control device which is directly connected to the load. Footcandle level shall be set 50 fc (300 lux) or as noted on the drawings.

D. Dimming sensors shall interface with the lighting fixture(s) in one of the following ways:

1. The photo sensor shall interface with a 0 to 10 VDC controllable electronic dimming ballast. Dimming sensor shall connect directly to the ballast with 2 low voltage wires. Photo sensing element shall be a photoelectric sensor. Sensors shall be closed loop for single zone control or open loop for multi-zone control.
2. The photo sensor shall interface with a control module that operates one or more 0 to 10 VDC controllable electronic dimming ballasts. Dimming sensor shall connect directly to the control module with 2 low voltage wires. Photo sensing element shall be a photoelectric sensor. Sensors shall be closed loop for single zone control or open loop for multi-zone control

2.6 STAND ALONE ROOM AUTOMATIC CONTROLS

A. Manufacturers:

1. Subject to compliance with the contract documents, products of one of the following vendors are acceptable:
   a. nLight by Sensor Switch, Acuity Brands Lighting, Inc.;
   b. Wattstopper DLM
   c. Lutron Energi Savr Node
   d. Cooper Controls/Greengate Room Controller (for non-networked applications only)

B. Intelligent Room Controllers

1. Room Controllers must be designed to power and accept signals from remote low voltage sensors, or other control devices, and directly switch the line voltage of the desired load controlled.
2. Room Controllers must accept 120, 240, or 277 VAC utilizing a dual tap transformer.
3. Room Controllers shall allow power for auxiliary devices, depending on model.
4. Room Controller shall employ Zero Cross Circuitry for each load, and shall be capable of switching a 20A load and dimming 0-10V loads. In addition, controllers shall be capable of dimming alternate methods, including but not limited to incandescent dimming, magnetic low voltage, forward phase electronic low voltage and LED drivers, and dimmable two-wire and three-wire fluorescent loads.
5. Room Controllers shall have 1, 2, or 3 switch legs, but no more than a 20A load per device.

C. Ceiling Mounted Occupancy Sensors

1. Ceiling mounted dual technology digital (passive infrared and ultrasonic or microphonic) occupancy sensor. Furnish the Company's system which accommodates the square-foot coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors and accessories which suit the lighting and electrical system parameters.

2.7 PHOTO SENSORS

A. The photo sensor shall interface with multi-input digital addressable dimming ballasts. Dimming sensor shall connect directly to the ballast or module with 4 low voltage wires. Photo sensing element shall be a photoelectric sensor. Sensors shall be closed loop for single zone control or open loop for multi-zone control.

2.8 CONTROL RELAYS

A. Industrial Control Relays: Rated 600V, 20A convertible contacts. Square D Class 8501 XMO series.

B. General Purpose Relays: Rated 120/ 240 volt, 10A. Square D Class 8501 Type K plug in series with screw terminal socket.

2.9 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG, complying with Section 260519 - Low Voltage Electrical Power Conductors and Cables.

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded copper conductors not smaller than No. 22 AWG, complying with Section 260519 - Low Voltage Electrical Power Conductors and Cables. Provide plenum rated as required.

C. Class 1 Control Cable: Multiconductor cable with stranded copper conductors not smaller than No. 18 AWG, complying with Section 260519 - Low Voltage Electrical Power Conductors and Cables. Provide plenum rated as required.

D. Install unshielded, twisted-pair cable for control and signal transmission conductors, complying with Section 260519 - Low Voltage Electrical Power Conductors and Cables. Provide plenum rated as required.

2.10 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch (1mm) thick, satin-finished, Type 302 stainless steel
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve at least 90 percent coverage of areas indicated. Install sensors in accordance with manufacturer's instructions. Do not exceed coverage limits specified in manufacturer's written instructions.

C. Where sensors are integral to light fixtures, coordinate orientation and location of fixture with sensor position.

3.2 DEVICE INSTALLATION

A. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

B. Arrangement of Devices: Group adjacent switches under single, multigang wall plates.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Section 260519 - Low Voltage Electrical Power Conductors and Cables.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 - Identification For Electrical Systems.

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with manufacturers' commissioning checklist and section 260126 Maintenance and Testing of Electrical Systems.
2. Operational Test: Verify actuation of each sensor and adjust time delays.

B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 SYSTEM STARTUP AND COMMISSIONING

A. Commissioning shall take place prior to demonstration of system to Owner. After the system has been installed the Contractor shall provide manufacturer’s recommended commissioning with factory trained and authorized technicians on-site, to:

1. Verify that the contractor has properly installed and interconnected all necessary components.
2. Verify correct operation of all system components.
3. Verify that all switch and contact inputs are in compliance with contract requirements.
4. Occupancy sensors and photo-sensors: Ensure that each sensor is correctly placed and oriented to provide the intended function. Adjust sensor location if unanticipated obstructions are present that impede the proper operation of the device.
5. Occupancy Sensors: Adjust sensitivity and time delay of the occupancy sensor and test to ensure it provides appropriate response. Set initial time delay for 15 minutes.
6. Dual Technology Type Occupancy Sensors: If interferences occur, disable either PIR or ultrasonic technology as appropriate for application.
7. Daylight harvesting: Calibrate sensors after all furnishings and interior finishes are installed. Adjust photo-sensor to determine the threshold for switching based upon the detected light level. Calibrate sensor under normal daylight levels and dusk light levels.

8. Submit completed verification checklist.

3.7 OWNER'S INSTRUCTIONS AND SYSTEM DEMONSTRATION

A. System Demonstration

1. Schedule demonstration a minimum of two-weeks prior to system turn over and substantial completion. Schedule with owner's representative and electrical engineer.

2. Demonstrate complete system operation and contract compliance to designated owner's representative and engineer to prove system is functional and ready for comprehensive training.

B. System Instruction

1. The Contractor shall after one week (minimum) written notification to Architect conduct an instruction session during which all maintenance and operational aspects of the system will be described and demonstrated to personnel selected by the Owner. The session shall be conducted by a Contractor's representative thoroughly familiar with the characteristics of the system. O & M manual information regarding the system shall be turned over to the Architect prior to scheduling the instruction session.

2. Training shall utilize the following draft documents:

   a. Draft O&M Manual

   b. Contractor's record drawings

   c. The training effort shall validate the O&M Manual and record drawing documentation.

END OF SECTION 26 09 23

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 260500 Common Work Results, apply to this Section.

1.2 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.

    a. Verify space available with equipment sizes and code required working clearances prior to submitting shop drawings.

2. Detail enclosure types and details for types other than NEMA 250, Type 1.

3. Detail bus configuration, current, and voltage ratings.

4. Short-circuit current rating of panelboards and overcurrent protective devices.

5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

6. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards, include selectable ranges for each type of overcurrent protective device.

C. Seismic Data:

1. ASCE7 Special Certificate: Submit manufacturer’s Special Certification that panelboards, overcurrent protective devices, accessories, and components will comply with the required seismic performance. Detailed description of equipment support and anchorage devices on which the certification is based and their installation requirements.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity, and locate and describe mounting and anchorage provisions.

D. 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.

E. Panelboard Schedules: For installation in panelboards.

F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.4 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 GENERAL

A. Comply with:

1. NEMA PB2.

2. UL 67.

3. UL 50 for cabinets boxes and trims.

4. NFPA 70.

5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

6. Labels as required by UL and NFPA 70, as adopted and amended by local codes.

B. Seismic Criteria:

1. Provide Special Certification for Designated Seismic systems per ASCE/SEI 7 Chapter 13, *Seismic Design Requirements for Nonstructural Components*. Testing shall be in accordance with the following:

a. ICC ES 156 *Seismic Certification By Shake Table Testing of Non-Structural Components*.

b. Test shall utilize the following criteria from ASCE/SEI 7

1) Importance factor, *Ip*, of 1.5.

2) Height Factor (z/h) = 0, or as individually determined for each switchboard from contract drawings.

3) Ground acceleration, testing force, duration, frequency bandwith and related site factors shall meet or exceed the requirements determined by the performance criteria defined in Section 260548 "Seismic Controls for Electrical Systems". Where information is unavailable (ie a_p) use the most imposing values identified in ASCE/SEI 7.

c. A current listing on the State of California's OSHPD Special Seismic Certification Preapproval list with an S_{DS} value adequate for the site may be used to demonstrate compliance with these criteria.

2. Panelboard shall remain in place without separation of any parts when subjected to seismic forces and the unit will be fully operational after the seismic event. Identify mounting and anchoring hardware compatible with the points of attachment to the Panelboard.

2.2 MANUFACTURER

A. Manufacturers: Subject to compliance with requirements, provide products or comparable product by one of the following:

1. Eaton Electrical Inc
2. General Electric Company
3. Schneider Electric.

2.3 ENCLOSURES

A. Surface-mounted cabinets

B. Rated for environmental conditions at installed location.

1. Indoor Dry and Clean Locations: NEMA 250, Type 1.

C. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover (door in door). Key identically.

D. Finishes:

1. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

2. Back Boxes: Steel, galvanized where construction sequencing exposes the back box to water, otherwise same finish as panels and trim.

E. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover, type written. Hand written is not acceptable.

2.4 BUSSING AND WIRING

A. Incoming Mains Location: Top or bottom, as determined by contractor in conjunction with information presented on the drawings.

B. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Panelboards shall have full ampacity bussing throughout and shall be full size in regard to number of possible pole spaces. Bussing shall be identified with phases reading left to right.
3. Neutral bus shall be mounted independently of equipment ground bus.
4. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box and located on back of panelboard. Shall have lug or lugs from equipment grounding conductor from switchboard or distribution board and screw type terminals for connection of equipment green ground wire in same quantity as number of poles in panel.

C. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Method: Mechanical Screw type.
3. Features as scheduled:
    a. Feed-Through Lugs. Locate at opposite end of bus from incoming lugs or main device.
    b. Subfeed (Double) Lugs: Locate at same end of bus as incoming lugs or main device.

D. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

E. Panelboard Short-Circuit Current Rating: Refer to Panel Schedules and one line diagrams.

1. Fully rated to interrupt symmetrical short-circuit current available at terminals.
2. Minimum interrupting ratings shall be 14,000 (RMS Symmetrical) at 480/277V and 10,000 (RMS Symmetrical) at 208/120V.

2.5 OVERCURRENT PROTECTIVE DEVICES

A. Overcurrent Protective Devices shall be the same manufacturer as panelboard.

B. Fully rated for the available short circuit current.

C. Molded-Case Circuit Breaker (MCCB): Comply with UL 489. Standard frame sizes, trip ratings, and number of poles. Mechanical lugs, able to terminate conductors indicated on drawings.

1. Frame size 100A: Thermal-Magnetic sensing with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
2. Frame sizes over 100A and up to 800A: Thermal-Magnetic sensing with inverse time-current element for low-level overloads and adjustable instantaneous magnetic trip element for short circuits Adjustable instantaneous trip element shall have front-mounted dial or utilize electronic trip unit.

D. Circuit-Breaker Features and Accessories: Provide the following construction and ratings where indicated on the drawings:

1. Branch Circuits:
   a. GFCI Circuit Breakers: Ground Fault Circuit Interrupter, single- and two-pole configurations with Class A ground-fault protection (6-mA trip). Push to test and ground fault indicator.
   b. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).

E. Applications:

1. Circuit breakers shall have listing appropriate for the application.
2. Lighting Loads: Type SWD for switching fluorescent loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
3. Fire Alarm circuits: Handle clamp for holding circuit-breaker handle in on position to avoid accidental switching.

F. Where spare is indicated, panelboard shall be provided with the specified branch circuit breaker, full ampacity bussing and mounting hardware. Where space is indicated, panelboard shall be provided with full ampacity bussing and mounting hardware to accommodate future installation of branch circuit breaker. Provide individual filler/cover plates for each breaker space.

2.6 NAMEPLATES

A. Engraved nameplates per Section 260553 - Identification for Electrical Systems permanently attached to panelboard front.

B. Nameplate color: Normal system - white letters on black.
Emergency system - white letters on red.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NECA 407 and NEMA PB 1.1.

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.

3.2 INSTALLATION

A. Install panelboards and accessories according to NECA 407 and NEMA PB 1.1.

1. Secure flush mounted panels to studs in wall via slotted channel or angle iron.
2. Provide additional reinforcement where wall construction is inadequate for size and weight of panelboard.
3. Place and secure anchorage devices in masonry and concrete elements. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

C. Comply with mounting and anchoring requirements specified in Division 26 Section "Seismic Controls for Electrical Systems."

D. Mount top of panel trim according to the following priorities (highest listed first):

1. At the height determined by the panelboard when panelboard size and weight require floor mounting.
2. In compliance with the operating handle height limitation of the NEC.
3. At the height indicated on the drawings.
4. As necessary to permit adjacent panels in finished areas to have trim heights aligned.
5. At 90 inches for panel cabinets above 42 inches in height, and at 78 inches for panel cabinets equal to or less than 42 inches in height.

E. 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.

F. Locate in dedicated spaces. Coordinate project construction so piping, ducts, etc. are routed around dedicated spaces above and in front of panelboards per code.

G. Verify space available with equipment sizes and code required working clearances prior to roughing in of back box or cabinet.

H. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

I. Install filler plates in unused spaces.

3.3 WIRING

A. Conform to applicable sections of these specifications and NEMA PB 1.1.

B. Panelboards shall be wired and connected after installation at locations shown. Pre-wiring off site and splicing of branch circuit in wireway above or below panelboard is not permitted.

3.4 CIRCUIT INDEX AND LABELS

A. Typed circuit index with odd circuits on left, even circuits on right, listing each circuit by number with complete load designation, (i.e. Receptacle room ___, lights room ___, etc.). Room names/numbers per actual room identification assigned by owner at project completion (assigned room numbers may differ from drawings). Mount inside door with transparent protective cover. Provide number labels on circuit breakers to match index.

B. Install nameplate as per Part 2.

3.5 GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Route grounding conductors 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.

3.6 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. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

C. 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.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. 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.

3.7 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 directed and in accordance with Division 26 Section "Overcurrent Protective Device Coordination Study**."**]

3.8 CLEANING

A. Prior to final inspection, clean panelboard interiors, adjust trims, covers, hinges and locks and refinish marred or scratched covers to original conditions. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.9 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Wall-box motion sensors.
4. Weather-resistant receptacles.
5. Combination receptacles and USB chargers.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.7 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).

3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand (Pass & Seymour).

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

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. Cooper; 5351 (single), CR5362 (duplex).
   b. Hubbell; HBL5351 (single), HBL5352 (duplex).
   c. Leviton; 5891 (single), 5352 (duplex).
   d. Pass & Seymour; 5361 (single), 5362 (duplex).

2.4 GFCI RECEPTACLES

A. General Description:

1. Straight blade, non-feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A (including auto monitoring and end of life power denial requirements), and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

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. Cooper; VGF20.
   b. Hubbell; GFR5352L.
   c. Pass & Seymour; 2095.
   d. Leviton; 7899.

2.5 TWIST-LOCKING RECEPTACLES

A. Single Convenience Twist-Lock Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

   a. Cooper; CWL520R.

b. Hubbell; HBL2310.

c. Leviton; 2310.

d. Pass & Seymour; L520-R.

2.6 COMBINATION RECEPTACLES/USB CHARGERS

A. General Description

1. Comply with NEMA WD 1, NEMA WD 6, configuration 5-20R, UL498 and FS W-C-596.
2. USB rated for 2A minimum at 5V (10VA) of charging power.
3. Shall fit in standard single gang box.

B. Straight blade duplex receptacle, 125V, 20A with two USB charging ports.

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. Cooper; TR7756.

b. Hubbell; USB20x2.

c. Leviton; T5632

2.7 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch (1mm) thick, satin-finished, Type 302 stainless steel
3. Material for Unfinished Spaces: Galvanized steel.
4. 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 cover.

2.8 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: Gray unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.

PART 3 - EXECUTION

3.1 INSTALLATION

A. 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.

B. 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 NFPA 70, 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.

C. 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. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
7. Tighten unused terminal screws on the device.
8. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

D. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

E. 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.

F. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top.

3.2 RECEPTACLES

A. Provide exterior GFCI receptacle within 25'-0" of each roof mounted mechanical equipment, for all outdoor receptacles, and other locations shown on the drawings.

B. Provide tamper resistant receptacles in exam and waiting areas.

3.3 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.4 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

3.5 CLEANING

A. Remove excess plaster from interior of outlet boxes.

B. Clean devices and cover-plates after painting is complete. Replace stained or improperly painted devices or cover-plates.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-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. Receptacle Polarity Test: Test every receptacle installed or reconnected under this contract with a receptacle circuit tester. Tester shall test for open ground, reverse polarity, open hot, open neutral, hot and ground reversed, hot or neutral and hot open. Rewire receptacles with faults and retest. Submit statement of completed testing signed by the electrician that performed the test.
6. Ground-Fault Receptacle Circuit Interrupter Tests: Test each receptacle or branch circuit breaker having ground-fault circuit protection to assure that the ground-fault circuit interrupter will not operate when subjected to a ground-fault current of less than 4 milliamperes and will operate when subjected to a ground-fault current exceeding 6 milliamperes. Perform testing using an instrument specifically designed and manufactured for testing ground-fault circuit interrupters. Apply the test to the receptacle. "TEST" button operation will not be acceptable as a substitute for this test. Replace receptacles that do not shutoff power with 7/1000 of an ampere within 1/40th of a second and retest.

7. Using the test plug, verify that the device and its outlet box are securely mounted.

8. 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.

B. Wiring device will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 26 27 26

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Enclosures.

B. Provide all disconnects required by code for equipment furnished under this and other Divisions of these specifications unless disconnects are integral with equipment and acceptable to the authority having jurisdiction.

1.3 REFERENCES

A. National Electrical Manufacturers Association (NEMA)

B. Underwriters Laboratories (UL)

1.4 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.5 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."

1.6 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. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
5. 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. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.7 INFORMATIONAL SUBMITTALS

A. 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.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches.

1.9 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 three of each size and type.
2. Fuse Pullers: Two for each size and type.

1.10 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

1.11 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 (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m).

1.12 COORDINATION

A. Coordinate layout and installation of switches and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc
2. General Electric Company.
3. Schneider Electric.

2.2 RATINGS

A. Voltage: Meet or exceed voltage of the circuit the switch is applied to.

B. Current

1. Continuous current rating shall be either of the following:
   a. As indicated on the drawings.
   b. If not indicated, match or exceed the continuous current rating of the over-current protective device that protects the conductor providing incoming power to the switch
2. Short circuit withstand and interrupting ratings
   a. Shall comply with either of the following:
      1) If the available short circuit current at the switch is indicated on the drawings, exceed the indicated value while allowing for appropriate X/R derating.
      2) Meet or exceed the AIC rating of the overcurrent protective device that protects the conductor providing incoming power to the switch.
   b. Compliance: Short circuit withstand and interrupting ratings shall be complied with using any of the following methods:
      1) Listed short circuit ratings complying with above criteria.
      2) Oversizing the indicated switch rated current to obtain a listed short circuit withstand and interrupting rating complying with the above criteria, if the appropriate amount of space is available at the indicated location.

3) If a nonfusible disconnect is indicated it may be changed to a fusible disconnect to obtain the required listed short circuit current withstand rating.

3. Overcurrent Protection

a. Provide overcurrent protection matching the ampacity indicated on the drawings.

b. When included as part of the disconnecting means for utilization equipment the overcurrent protection shall comply with the listing requirements of the utilization equipment. Obtain utilization equipment shop drawings as specified in the appropriate specification division to determine requirements.

C. Poles: Match the circuit the switch is applied to.

2.3 FUSIBLE SWITCHES

A. Type HD, Heavy Duty, Single Throw, Larger than 100 amp: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

B. Accessories:

1. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

2.4 NONFUSIBLE SWITCHES

A. Type HD, Heavy Duty, Single Throw, Larger than 100 amp. UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

2.5 ACCESSORIES

A. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

B. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

C. Neutral Kit: Required where neutral conductor is indicated on the drawings. Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

D. Additional accessories, where indicated

1. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

2. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.

3. Alarm Switch: One SPDT contact that operates only when switch has tripped.

2.6 ENCLOSURES

A. Enclosed Switches: 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.

2.7 NAMEPLATES

A. Provide nameplates per Section 260553 - Identification For Electrical Systems.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches level and plumb according to manufacturer's written instructions.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Seismic Controls for Electrical Systems."

C. Securely mount adjacent to equipment on wall or acceptable mounting frame. Disconnect switches shall be mounted independent from the equipment they serve. Disconnects supported only by raceway are not acceptable.

D. Wiring space within Disconnects or Fused Switches or shall not be used for splices.

E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

F. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

G. Install fuses in fusible devices.

H. Comply with NECA 1.

3.3 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

3.4 IDENTIFICATION

A. Comply with requirements in Division 26 Section "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.

3.5 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch, component, connecting supply, feeder, and control circuit rated 100A or greater.
2. Test continuity of each circuit.

B. 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. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

C. Enclosed switches will be considered defective if they do not pass tests and inspections.

D. 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.

3.6 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 directed.

END OF SECTION 26 28 16

SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior lighting fixtures.
2. Exit signs.
3. Lighting fixture supports.

B. Related Sections:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 262726 "Wiring Devices" for manual wall-box dimmers and switches.

1.3 REFERENCES

A. National Electrical Manufacturer's Association (NEMA) LE5-1993:

1. Procedure for determining Luminaire efficiency ratings.

B. Underwriters Laboratories, Inc. (UL):

UL 924:	Emergency Lighting and Power Equipment
UL 1012	Power Units Other Than Class 2
UL 1310	Class 2 Power Units
UL 1598	Luminaires

1.4 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. LER: Luminaire efficacy rating.

D. Lumen: Unit of luminous flux. Photometrically, it is the luminous flux emitted within a unit solid angle by a point source having a uniform luminous intensity of 1 candela.

E. Luminaire: Complete lighting fixture, including ballast, lamp, housing, parts designed to distribute the light, to position and protect the lamps, and to connect the lamps to the power supply.

1.5 SYSTEM DESCRIPTION

A. Light fixture schedule series numbers are a design series reference and do not necessarily represent the exact catalog number, size, voltage, wattage, type of lamp, finish trim, ceiling type, mounting hardware, ceiling trim or special requirements as specified hereinafter or as required by the particular installations. Provide complete fixtures to correspond with the number of lamps, wattage and/or size specified.

B. If there are discrepancies between fixture illustrations and the written description in the fixture schedule, the written description in the fixture schedule shall take precedence.

C. Light fixture voltage shall match voltage of circuit serving the light fixture.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Replacement cost of entire fixture, of the driver, or one LED board, for each fixture type.
3. Submit list of spare parts with quantities to be furnished to the Owner.
4. Emergency lighting units including battery and charger.
5. Product Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
6. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Shop Drawings: For nonstandard or custom lighting fixtures. 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.

C. Pendant support system if part of fixture.

1.7 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1. Provide cut sheets of all fixtures and control devices.
2. Provide instruction manuals for all control systems.

1.9 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. LED power supplies/drivers: Provide 10% of installed quantity or ten (10) of each type used on the project (whichever is greater). Turn over to Owner and obtain signed receipt.
2. Fixture Lenses and Supporting Hardware: 10% or a minimum of ten (10) (whichever is greater) of each type used on the project. Turn over to Owner and obtain signed receipt.
3. LED Modules: Provide 10% of installed quantity or ten (10) of each type used on the project (whichever is greater). Turn over to Owner and obtain signed receipt.

1.10 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

1.11 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.12 WARRANTY

A. Exit Signs Utilizing LED Lamp Technology: Provide manufacturer’s warranty for a period of not less than five years including parts and labor for full replacement of defective product.

B. LED Luminaires: Provide manufacturer's warranty for a period of not less than ten years for repair or replacement of defective electrical parts, including light source and power supplies.

PART 2 - PRODUCTS

2.1 GENERAL MATERIAL REQUIREMENTS

A. Finish ferrous mounting hardware and accessories to prevent corrosion and discoloration to adjacent materials.

B. Fixtures shall be free of light leaks and designed to provide sufficient ventilation of lamps to provide the photometric performance required. Ballasts and transformers shall be adequately vented.

C. All sheet metal work shall be free from tool marks and dents and shall have accurate angles bent as sharp as compatible with the gauges of the required metal. Intersections and joints shall be formed true and of adequate strength and structural rigidity to prevent any distortion after assembly. Finish exposed edges so no sharp or ragged edges are exposed. All miters shall be in accurate alignment with abutting intersecting members.

D. Reflector Cones:

1. Plastic materials shall not be used for reflector cones, unless noted otherwise in the Light Fixture Schedule.
2. Reflector cones shall not be riveted or welded to housing and shall be removable without tools. Retention devices shall not deform the cone in any manner. Trim shall be flush with finished ceiling without gaps or light leaks. Where the flange trim is separate from the cone, it shall have the same finish as the cone.
3. Reflector cones shall be of uniform gauge, not less than 0.032-inch thick, high purity aluminum Alcoa 3002 alloy, free of spin marks or other defects.
4. Manufacture reflector under the Alzak process. Refer to fixture schedule for cone color and specular or diffuse finish requirements

E. For adjustable fixtures, provide positive locking devices to fix aiming angle. Fixture shall be capable of being relamped without adjusting aiming angle.

F. Fixtures recessed in suspended ceilings where the space above the ceiling is either an air supply or return plenum shall conform to NEC Article 300-22.

G. Safety: Provide safety devices for removable fixture elements (cones, reflectors, lenses, etc.) to support removable elements when not in normal operating position. Safety devices shall be detachable if necessary and shall not interfere with fixture performance, maintenance or the seating of any fixture element, and not be visible during normal fixture operation.

2.2 LIGHT EMITTING DIODE (LED) FIXTURES:

A. Housing: Rigid aluminum construction.

B. Finish: Visible surfaces. Powder coated paint or natural aluminum as specified in Light Fixture Schedule. Color and finish as selected by architect. Concealed parts, (lamp holders, yokes, brackets, etc.) matte black.

C. Lamp Holder Housing: Cast aluminum with integral heat radiating fins to assure cool lamp base operation, with sufficient heat dissipation to meet device manufacturer's guidelines, certification programs, and test procedures for thermal management.

D. Off-state Power: Luminaires shall not draw power in the off state. Exception: Luminaires with integral occupancy, motion, photo-controls or individually addressable fixtures with external control and intelligence are exempt from this requirement. The power draw for such luminaires shall not exceed 0.5 watts when in the off state.

2.3 WIRING

A. Wiring shall be as required by code for fixture wiring.

B. Flexible cord wiring between fixture components or to electrical receptacle and not in wireways shall have a minimum temperature rating of 105°C.

C. Cords shall be fitted with proper strain reliefs and watertight entries where required by application.

D. No internal wiring shall be visible at normal viewing angles, i.e. above 45° from vertical.

2.4 POWER SUPPLIES:

A. LED Power Supplies:

1. Minimum power factor 90%.
2. Minimum operating temperature of -20°C.
3. Output operating frequency shall be minimum 120 Hz.
4. Power supply shall meet FCC requirements for non-consumer use.
5. Sound rating: Class A.
6. Power supply shall comply with IEEE C.62.41-1991, Class A operation.

2.5 LAMPS

A. Light Emitting Diode Type:

1. LED modules/arrays shall have a minimum CRI of 80 unless otherwise specified in the Light Fixture Schedule.
2. Color temperature variation shall not exceed +/- 100 degrees Kelvin at installation, and +/- 200 degrees Kelvin over the life of the module.
3. LED modules/arrays shall deliver at least 70% of initial lumens, when installed in-situ, for a minimum of 35,000 hours.
4. Acceptable manufacturers: Cree, Philips, Nichia.

2.6 EMERGENCY BATTERY PACKS

A. Where fixtures are indicated or specified to have self-contained battery backup, provide battery pack(s) with 1100 lumen output operation or as indicated. Unit shall have high temperature nickel cadmium battery, automatic transfer switch, battery charger high frequency inverter, installed test/charging indicator and switch, dual voltage, and be UL listed to standard 924. Provide normal switching connection where indicated.

B. Testing: Apply power for 24 hours, disconnect power observe, measure and record light output for specified 90-minute period. Continue to run on battery until automatic low battery cut-off circuit disconnects battery. Restore normal power and verify battery returns to charging mode.

C. Warranty: Entire unit shall be warranted for 5 years, battery shall have 15-year life expectancy with 5 year full warranty and 7 additional years prorated warranty. Full warranty to cover labor and materials without charge. Prorated warranty to cover material only.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide mounting accessories and trims as required for wall and ceiling construction types shown in Finish Schedule and on Drawings.

B. Lighting fixtures:

1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
2. Install lamps in each luminaire.

C. Remote Mounting of Drivers: Distance between the driver and fixture shall not exceed that recommended by manufacturer. Verify requirements for maximum distance between driver and luminaire with manufacturers.

D. Verify weight and mounting method of fixtures and provide suitable supports. Fixture mounting assemblies shall comply with local seismic codes and regulations.

E. Refer to architectural reflected ceiling plans for coordination of lighting fixture locations with mechanical and fire safety equipment. Where conflicts occur, coordinate with Architect prior to installing any of the systems.

F. For fire rated ceilings and walls, provide rated enclosure for recessed light fixture, or coordinate with Architect and Lighting Designer to specify fixture suitable for use in rated ceiling or wall.

G. Install fixtures with vent holes free of air blocking obstacles.

H. Lighting fixtures located in recessed ceilings with a fire resistive rating of 1-hour or more shall be enclosed in an approved fire-resistive rated box equal to that of the ceiling.

I. Adjust aperture rings on all recessed fixtures to be flush with the finished ceiling.

J. Blemished, damaged or unsatisfactory fixtures or accessories shall be replaced.

K. For wall mounted fixtures, center on outlet box unless otherwise noted. Verify mounting provisions and other requirements prior to order of light fixtures and provide as required.

L. In accessible suspended ceilings, provide 72" flexible conduit wiring connection (flexible tubing not permitted) from a rigidly supported junction box.

M. All finishes shall be unmarred upon project completion. Repair or replace damaged finishes.

N. Replace all inoperative LEDs at the end of the construction prior to Owner occupancy.

3.2 DIFFUSERS AND ENCLOSURES

A. Remove protective plastic covers from lighting fixture diffusers only after construction work, painting and clean-up are completed. Remove all dirty reflectors and diffusers; clean and reinstall. When cleaning "Alzak" reflectors, use a manufacturer recommended cleaning solution. Reflectors damaged or impregnated with fingerprints shall be replaced at no cost to Owner.

B. For LED fixtures, whether surface mounted or recessed, remove all construction dirt and dust from heat sink fins to ensure proper dissipation of heat.

3.3 ADJUSTMENT OF LIGHT FIXTURES

A. Focus all adjustable light fixtures under the direction of the Architect during a scheduled period of time prior to the completion of the project, after normal business hours if required. Include all equipment and personnel expenses (including overtime) required for adjustment.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

1. Adjust aimable luminaires in the presence of Architect or Owner.

3.4 SUPPORT OF DOWNLIGHT STYLE LIGHT FIXTURES

A. Surface or Pendant Type: Attach heavy formed steel straps to the outlet box by means of threaded stems with locknuts, or directly to the outlet box where the light fixture is specifically so designed.

B. Recessed Type: Mount in frames suitable for the ceiling, with recessed portion of the fixture securely supported from the ceiling framing. Bottom of light fixture to be flush with adjacent ceiling. Fixture trim shall totally conceal ceiling opening. Provide two #14 earthquake chains or #12 wires when fixture is supported by ceiling suspension system.

3.5 SUPPORT OF LIGHT FIXTURES

A. Recessed type: For light fixtures supported by the ceiling suspension system, provide four Caddy #515 support clips (one each corner) which lock light fixture to ceiling tees after light fixture is installed. In addition, provide for each light fixture two #14 earthquake chains or #12 wires secured at diagonally opposite fixture corners (for fixtures weighing less than 56 pounds) to structural members above suspended ceiling. For plaster or gypsum board ceilings provide plaster frame compatible with light fixture. Contractor shall coordinate fixture trim with ceiling type.

B. Surface Mounted Type:

1. Where mounted on accessible ceilings, support from structural members above ceiling by means of hanger rods through ceiling or as approved.
2. Continuous Runs of Fixtures: Laser sight to assure fixtures are straight when sighting from end to end, regardless of irregularities in the ceiling. Where light fixtures are so installed, omit ornamental ends between sections.

C. Pendant Mounted Type:

1. For fixtures with rigid pendants, supply swivel ball aligners at canopy to comply with local seismic requirements.
2. Where suspended from accessible ceiling, support fixture from structural members above ceiling by means of hanger rods through ceiling or as accepted.
3. Continuous Runs of Light Fixtures: Laser sight to assure fixtures are straight when sighting from end to end, regardless of irregularities in the ceiling. Where light fixtures are so installed, omit ornamental ends between sections.
4. Where pendant is longer than 48 inches (1200mm), brace to limit swinging.

3.6 CEILING LIGHT FIXTURE SUPPORT

A. Where ceiling is of insufficient strength to support weight of lighting fixtures installed, provide additional framing to support as required.

END OF SECTION 26 51 00

SECTION 27 05 00 - COMMON WORK RESULTS FOR COMMUNICATIONS

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.

B. Section 270526 – Grounding and Bonding for Communications Systems

C. Section 270529 – Hangers and Supports for Communications Systems

D. Section 270533 – Conduits and Backboxes for Communications Systems

E. Section 270544 - Sleeves and Sleeve Seals for Communications, Pathways and Cabling

F. Section 271500 - Communications Horizontal Cabling

G. Section 283111 - Digital, Addressable Fire-Alarm System

1.2 SUMMARY

A. This section includes general requirements for all Division 27 work and is supplemental and in addition to the requirements of Division 1.

B. It is the intention of this Division of the Specifications and the Contract Drawings to describe and provide for the furnishing, installing, testing and placing in satisfactory and fully operational condition all equipment, materials, devices and necessary appurtenances to provide a complete communication system. Provide all materials, appliances and apparatus not specifically mentioned herein or shown on the drawings, but which are necessary to make a complete, fully operational installation of all communications systems shown on the contract drawings or described herein. Connect equipment and devices furnished and installed under other Divisions of this specification (or the Owner) under this Division.

C. Workmanship shall be of the best quality and competent and experienced technicians shall be employed and shall be under the supervision of a competent and experienced foreman.

D. The drawings and specifications are complementary and what is called for (or shown) in either is required to be provided as if called for in both. Where conflicting information occurs within the drawings and specifications or between the drawings and specifications, the more expensive alternative shall be used as a basis for bidding and construction.

E. See Division 01 for sequence of work.

1.3 WORK IN OTHER DIVISIONS

A. See all other specifications for other work which includes but is not limited to:
Cutting and Patching
Door Hardware
Electronic Safety and Security
Equipment Wiring
Fire Stopping

Mechanical Control Wiring
Mechanical Equipment
Painting, Refinishing and Finishes
Temporary Power

1.4 CODES, PERMITS, INSPECTION FEES

A. The following codes and standards are referenced in the Division 27 specifications. Perform all work and provide materials and equipment in accordance with the latest referenced codes and standards of the following organizations:

1. American National Standards Institute (ANSI)
2. National Electrical Manufacturer's Association (NEMA)
3. National Fire Protection Association (NFPA)
4. Underwriter's Laboratories (UL)
5. American Society for Testing and Materials (ASTM)
6. BICSI (A Telecommunications Association)
7. International Building Code (IBC)
8. Insulated Cable Engineers Association (ICEA)
9. Institute of Electrical and Electronic Engineers (IEEE)
10. Federal Communications Commission Rules and Regulations (FCC)
11. National Electrical Code (NFPA Article 70) (NEC)
12. National Electrical Safety Code (NESC)
13. Occupational Safety and Health Administration (OSHA)
14. Rural Utilities Service (RUS)
15. Telecommunications Industry Association (TIA)
16. Electronics Industry Alliance (EIA)
17. Uniform Building Code (UBC)
18. UL 2043 & UL 2239
19. NEMA VE1 & VE2

B. Install the communications systems based on the following:

NFPA 70 National Electrical Code as adopted and amended by the Local Jurisdiction.

IBC International Building Code as adopted and amended by the Local Jurisdiction.

C. Communications Specific:

1. TIA/EIA-455: Fiber Optic Test Standards
2. TIA-526: Optical Fiber Systems Test Procedures

3. TIA/EIA-568-C.2: Commercial Building Telecommunications Cabling Standard
4. TIA-568-0.D
5. TIA-568-3.D
6. TIA-526-7-A
7. TIA-526-14-C
8. TIA-569-D: Commercial Building Standard for Telecommunications Pathways and Spaces
9. TIA-606-B: Administration Standard for Commercial Telecommunications Infrastructure
10. ANSI/TIA-607-C: Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
11. TIA-758-B: Customer-owned Outside Plant Telecommunications Infrastructure Standard
12. TIA-942-B: Telecommunications Infrastructure Standard for Data Centers
13. TIA/EIA: Technical Service Bulletins (TSBs) (related to the above TIA/EIA standards)
14. IEEE 802.11 Wireless Local Area Network Standard, including the IEEE 802.11a, 802.11b, 802.11g, and 802.11n standards
15. BICSI: BICSI Customer Owned Outside Plant Design Manual, Latest Edition
16. BICSI: BICSI LAN and Internetworking Design Manual, Latest Edition
17. BICSI: BICSI Telecommunications Distribution Methods Manual, Latest Edition
18. BICSI: BICSI Telecommunications Cabling Installation Manual, Latest Edition
19. NEC: NFPA 70
20. FCC Part 68: Connection of Terminal Equipment to Telephone Network.

D. The referenced codes establish a minimum level of requirements. Where provision of the various codes conflict with each other, the more stringent provision shall govern. If any conflict occurs between referenced codes and this specification, the codes are to govern. Compliance with code requirements shall not be construed as relieving the Contractor from complying with any requirements of the drawings or specifications which may be in excess of requirements of the governing codes and rules and not contrary to same.

E. Obtain and pay for all licenses, permits and inspections required by laws, ordinances and rules governing work specified herein. Arrange for inspection of work by the inspectors and give the inspectors all necessary assistance in their work of inspection.

1.5 COORDINATION

A. Coordinate work with that of the other Contractors and/or other trades doing work on the project. Examine all drawings and specifications of other trades for construction details and coordination. Make every reasonable effort to provide timely notice of work affecting other trades to prevent conflicts or interference as to space requirements,

dimensions, openings, block-outs, sleeving or other matters which will cause delays or necessitate work-around methods.

B. Obtain submittals and shop drawings of all equipment with electrical connections furnished under other divisions of the specification and by the Owner. Provide all wiring in accordance with specific equipment requirements. Immediately advise the Architect of any changes which may affect the contract price.

C. Special attention is called to the following items. Coordinate all conflicts prior to installation:

1. Location of grilles, pipes, sprinkler heads, ducts and other mechanical equipment so that all communications outlets and equipment are clear from and in proper relation to these items.

2. Location of cabinets, counters and doors so that communications outlets, and equipment are clear from and in proper relation to these items.

3. Recessing and concealing communications materials in CMU walls, concrete construction and precast construction.

4. In every telecommunication room with either active or passive equipment the Contractor shall monitor the work of all trades to assure that the space and clearance requirements of code are met.

5. Review specifications for other Divisions of the work to determine where other Divisions are requiring communication connections. Verify provisions shown on contract drawings by examining shop drawing submittals of other Divisions prior to submission to the Owner. Do not proceed with ordering of supporting equipment, until characteristics are verified. Proceed with rough-in only after verification of shop drawings.

D. Digital format copies of bid drawings will be furnished to the successful bidder. Augment bid documents with additional information to ensure coordination between trades. Provide digital format communications systems drawings showing all ceiling devices, fixtures, raceways and cable tray locations and routing to mechanical contractor to be used for coordination drawings provided by mechanical contractor. Include dimensions and elevations of devices, fixtures, raceway and cable tray.

E. Furnish, install and place in satisfactory condition all raceways, boxes, conductors and connections and all other materials required for the communication systems shown or noted in the contract documents to be complete, fully operational and fully tested upon completion of the project. Raceways, boxes and ground connections are shown diagrammatically only and indicate the general character and approximate location. Where routings of major raceways and telecommunication pathways are indicated on plan sheets, the routing information supplements the information on diagrams. If no routing information is shown, route the systems in a manner that will coordinate with new and existing infrastructure and the work of other trades.

F. Consult the architectural drawings for the exact height and location of all communication and electrical equipment not specified herein or shown on the drawings. Make any minor changes (less than 6'-6" horizontal) in the location of the raceways, outlets, boxes, devices, wiring, etc., from those shown on the drawings without extra charge, where coordination requires or if so directed by the Architect before rough-in.

G. Provide inserts or sleeves for outlet boxes, conductors, cables and/or raceways as required. Coordinate the installation thereof with other trades.

H. The Contractor will not be paid for relocation of work, cuttings, patching and finishing required for work requiring reinstallation due to lack of coordination prior to installation.

1.6 APPROVED CONTRACTOR

A. Contractor shall be both an approved Ortronics Certified Install Plus (CIP) and a certified Corning Cabling System NPI Installer within the State of Oregon.

1.7 WARRANTY

A. Ortronics/Superior Essex nCompass Limited Lifetime warranty for horizontal subsystem.

1. nCompass Category 6+ cabling, connectivity hardware and patch cables shall be covered by a, nCompass Limited Lifetime warranty labor and application assurance warranty. The application assurance portion shall provide coverage for the cabling system to support the applications that are designed for the specifications outlined in ANSI/TIA/EIA 568-C.0-2. These applications include but are not limited to10BASE-T, 100BASE-T, 1000BASE-T and 155 Mb/s ATM.

2. Corning 25-year Warranty for fiber optic riser and outside plant backbone subsystems.

1.8 CORRECTION OF WORK

A. Within one year after the date of Substantial Completion of the work, the Contractor shall correct any work found to be not in conformance with the Contract Documents promptly after written notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. This obligation shall survive acceptance of the work under this Contract and termination of the Contract. The Owner shall give such notice promptly after discovery of the condition.

1.9 ITEMIZED SCHEDULE OF COSTS

A. Complete the Schedule of Values included at the end of this section. This schedule shall be adhered to for the communication contractor to facilitate analysis and approval of the monthly progress billings. Refer to the Supplementary Conditions of General Contract and Division 1 - General Requirements for details, and conform thereto. Provide a copy directly to Stantec.

1.10 SUBMITTALS AND SHOP DRAWINGS

A. Comply with Division 01.

B. Product Submittals shall show:

1. Indicate listing by UL or other approved testing agency.

2. Highlight with yellow or blue marker adequate information to demonstrate materials being submitted fully comply with contract documents.

3. Review and check all material prior to submittal and stamp "Reviewed and Approved".
4. Provide Manufacturer and/or lab certification that all product materials are PCB-free.

C. Contractor Qualification Data: Provide most recent valid certification documentation for installation technician, installation supervisor, and field inspector. These include BICSI ITS Installation Certifications and all relevant specific manufacture product installation certifications.

D. Shop drawings shall show:

1. Ratings of items and systems.
2. How the components of an item or system are assembled, interconnected, function together and how they will be installed on the project.
3. System layout floor plans with complete device layout, point-to-point wiring connection between all components of the system, wire sizes and color coding.
4. Coordinate with other division shop drawings and submittals. Identify interface points and indicate method of connection.
5. Communications Rooms: Submit 1/2" = 1'-0" detail plans and wall elevations of each room showing actual size of equipment in place. Identify coordinating elements such as structural beams or mechanical systems. Submittals shall show coordination among all suppliers of equipment, including power components, fire alarm, racks, nurse call, public address, security, etc. Submit room layouts at same time as material submittals, and prior to installation of any equipment.

1.11 PROJECT CLOSE-OUT

A. Coordinate with close-out provisions in Division 01 - General Requirements.

B. Request For Final Punchlist

1. To request a final low voltage punch list, forward a letter to Stantec, stating; "The communications work on this project is complete, all punch list items to date are complete, items a. - i. in the Punchlist Procure paragraph in Section 270500 - Common Work Results For Communications are complete and the project is ready for final punch list observation."
2. Project Punchlist Procedure: Perform the following procedures for project closeout of communications portions of work.
    a. Color code junction boxes per Section 260533 - Raceways and Boxes For Electrical Systems.
    b. Provide written warranty in O & M per the General Conditions of the Contract.
    c. Furnish Record Drawings per this section. Obtain signature on Job Completion Form.
    d. Furnish O & M Manuals per this section. Obtain signature on Job Completion Form.

e. Give instruction periods to Owner's personnel per this section. Obtain signature on Job Completion Form.

f. To request final acceptance of project, fill out Job Completion Form in this section and forward to Stantec. Note: If inspectors have not signed form, a copy of signed-off permits will suffice.

g. Include with Job Completion Form, a copy of the final punch list with the word "DONE", and the date and Contractor's initials after each item on the list.

1.12 COMMUNICATIONS EQUIPMENT OPERATION AND MAINTENANCE (O&M) MANUALS

A. Provide O&M manuals required in Division 01 - General Requirements plus one manual for Stantec for all equipment furnished under Division 27 - Communications of the specifications.

B. The information included must be the exact equipment installed. Where sheets show the equipment installed and other equipment, the installed equipment shall be neatly and clearly identified on such sheets.

C. These O&M manuals shall contain all the information needed to operate and maintain all systems and equipment provided in the project. Present and arrange information in a logical manner for efficient use by the Owner's operating personnel. The information provided shall include but not be limited to the following:

1. Equipment manufacturer, make, model number, size, nameplate data, etc.
2. Description of system configuration and operation including component identification and interrelations. A master control schematic drawings(s) may be required for this purpose.
3. Dimensional and performance data for specific unit provided as appropriate.
4. Manufacturer's recommended operation instructions.
5. Complete parts list including reordering information, recommended spares and anticipated useful life (if appropriate). Parts lists shall give full ordering information assigned by the original parts manufacturer. Relabeled and/or renumbered parts information as reassigned by equipment supplier not acceptable.
6. Shop drawings.
7. Wiring diagrams.
8. Signal equipment submittals shall contain step-by-step circuit description information designed to acquaint maintenance personnel with equipment operation in each mode of operation.
9. A complete list of local (nearest) manufacturer representative and distributor contacts for each type of equipment and manufacturer. Include name, company, address, phone, fax, e-mail address, and web site.
10. Cable test reports.

D. Furnish complete wiring diagrams for each system for the specific system installed under the contract. "Typical" line diagrams will not be acceptable unless revised to indicate the exact field installation.

1.13 INSTRUCTION PERIODS

A. After substantial completion of the work and 20 days after the O&M manuals have been delivered to the Owner and after all tests and final inspection of the work by the Authority(s) Having Jurisdiction; demonstrate the electrical systems and instruct the Owner's designated operating and maintenance personnel in the operation and maintenance of the various electrical systems. The Contractor shall arrange scheduled instruction periods with the Owner. The Contractor's representatives shall be superintendents or foremen knowledgeable in each system and suppliers representatives when so specified. When more than one training session is specified, the second session shall be 30 to 90 days after the first as agreed to by the Owner.

B. Include in each instruction session an overview of the system, presentation of information in maintenance manuals with appropriate references to drawings. Conduct tours of the building areas with explanations of maintenance requirements, access methods, servicing and maintenance procedures, equipment cleaning procedures and adjustment locations.

C. Include the following scheduled instruction periods:

		1st Session	2nd Session
1.	Communications System	4 hours	4 hours

D. Provide one professionally produced digitally recorded of each training session in DVD format. Furnish two (2) copies to the Owner.

1.14 RECORD DRAWINGS

A. Comply with Division 01.

B. Continually record the actual low voltage system(s) installation on a set of prints kept readily available at the project during construction. These prints shall be used for this purpose alone.

1. Mark record prints with red erasable pencil. Mark the set to show the actual installation where the installation varies substantially from the work as originally shown.

2. Accurately locate with exact dimensions all underground and underslab raceways and stub-outs.

3. Note changes of directions and locations, by dimensions and elevations, as utilities are actually installed.

4. Include addenda items and revisions made during construction.

5. Erase conditions not constructed or "X-out" and annotate "not constructed" to clearly convey the actual "as constructed" condition.

1.15 FINAL ACCEPTANCE REQUEST

A. Submit to the Architect, with a copy to the Stantec Engineer, a Stantec Job Completion Form (form attached in this section) properly filled out prior to the time final acceptance of the electrical work is requested.

1.16 ABBREVIATIONS AND DEFINITIONS

A. When the following abbreviations and definitions are used in relation to the work for Division 27 they shall have the following meanings:

Item	Meaning
AHJ	Authority Having Jurisdiction.
Boxes	Outlet, Junction or Pull Boxes.
Code	All applicable codes currently enforced at project location.
Compression	Compressed using a leverage powered (hydraulic or equivalent) crimping tool.
Connection	All materials and labor required for equipment to be fully operational.
Exterior Location	Outside of or penetrating the outer surfaces of the building weather protective membrane.
Fully Operational	Tested, approved, and operating to the satisfaction of the AHJ, manufacturer and contract documents.
Install	To enter or attach permanently into the project and make fully operational.
Mfr.	Manufacturer.
NEC	National Electrical Code, National Fire Protection Association, Publication #70.
Noted	Shown or specified in the Contract Documents.
Provide	Furnish and install.
Required	As required by code, AHJ, contract documents, or manufacturer for the particular installation to be fully operational.
Shown	As indicated on the drawings or details.
Wiring	Raceway, conductors and connections.
Accepted/Acceptable	Work or materials conforming with the intent of the project, and in general, conforming to the pertinent information in the Construction Documents.
Approved/Approval	The written approval of the Engineer.
Accessible/Easy access	Access attained without requiring extensive removal of other materials to gain access.
Accessible Ceiling	Acoustical tile hanging ceilings (“Hard-lid” ceilings even when provided with access panels, are not considered an Accessible Ceiling.)
Agreement	The contractual agreement between the Owner and the Contractor.
Communications Infrastructure System:	A communications Cabling System combined with a Communications Raceway System.

Concealed	Hidden from sight in interstitial building spaces, chases, furred spaces, shafts, crawl spaces, etc.
Construction Documents	Collective term for the entire set of bound or unbound material describing the construction and services required, including all Drawings, Specifications, addenda issued prior to execution of the contract, and modifications issued after Execution of the Contract (such as change orders, construction change directives, supplemental instructions, etc.).
The Contractor	The party responsible for providing the system(s) as indicated herein.
Drawings	The graphic and pictorial portions of the Contract Documents, wherever located and whenever issued, showing the design, location and dimensions of the Work, generally including (but not limited to) plans, elevations, sections, details, schedules and/or diagrams.
Engineer/Consultant	The party responsible for producing the communications system(s) Construction Documents.
Exposed	Not concealed (see above) and not installed underground.
Final Completion	The date when the Engineer confirms in writing that the Contractor has completed the work in accordance with the Construction Documents, including completion of all punch list items, cleanup work and delivery of all required guarantees, warranties, licenses, releases and other required deliverables.
Furnish	To purchase, supply, and deliver to the project materials in new and operable condition, ready for installation.
Governing Requirements	Collective term for regulations, laws, ordinances, codes, rules, standards, requirements, and guidelines that govern the installation and inspection of the work defined in the Contract Documents. See "Part 1 – General, 1.8 Governing Requirements" herein.
Governing Authorities	Entities or their representatives charged with formation and/or enforcement of Governing Requirements, such as the Authority Having Jurisdiction (AHJ).
Install	To place in final position in fully operable, tested condition.
Inside Plant (ISP)	Infrastructure within a building; includes raceways, cabling, termination components and racks/cabinets.
Or Equal, Or Equivalent	Materials approved for use by the Engineer and which are dimensionally suitable and operationally identical to the specified item.
Outside Plant (OSP)	Infrastructure exterior to a building.
Owner	The Owner and the Owner's designated representative(s).
The Project	The total construction of which the Work performed under the Contract Documents may be the whole or a part, and which may include construction by the Owner and/or separate contractors.

Substantial Completion	The date when all work required by the Construction Documents shall be complete (subject to the final punch list to be prepared by the Engineer) and on which the applicable jurisdictional authorities have issued a temporary certification of occupancy.
Section	An individual section of the Specifications.
Shown on Drawings	Noted, indicated, scheduled, detailed, or any other written reference made on the Drawings.
Specifications	The portion of the Contract Documents consisting of the written requirements for materials, equipment, construction systems, standards and workmanship for the Work and performance of related services.
Specification Section(s)	One or more sections of the Specifications.
Structured Cabling System (SCS)	Alternative term for Communications Cabling System
The Work	The construction and services required by the Contract Documents, whether completed or partially completed, and all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment installed shall have been tested and listed by Underwriters Laboratories or other approved testing organization and shall be so labeled unless otherwise permitted by the Authority Having Jurisdiction (Inspector).

B. All materials to be new, free from defects and not less than quality herein specified. Materials shall be designated to insure satisfactory operation and operational life in the environmental conditions which will prevail where they are being installed.

C. Each type of materials furnished shall be of the same make, be standard products of manufacturers regularly engaged in production of such materials and be the manufacturer's latest standard design.

D. All materials, equipment and systems furnished that include provisions for storing, displaying, reporting, interfacing, inputting, or functioning using date specific information shall perform properly in all respects regardless of the century. Any interface to other new or existing materials, equipment or systems shall function properly and shall be century compliant, both in regards to information sent and received.

E. All materials shall be PCB-free.

F. All paint to be low-VOC.

2.2 SUBSTITUTION OF MATERIALS

A. Comply with Division 01.

PART 3 - EXECUTION

3.1 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft. Handle all equipment carefully to prevent damage, breakage, denting, and scoring of finishes. Do not install damaged equipment.

B. Store products subject to damage by the elements above ground, undercover in a weather tight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instruction.

3.2 CUTTING BUILDING CONSTRUCTION

A. Obtain permission from the Architect and coordinate with other trades prior to cutting. Locate cuttings so they will not weaken structural components. Cut carefully and only the minimum amount necessary. Cut concrete with diamond core drills or concrete saws except where space limitations prevent the use of such tools.

B. All construction materials damaged or cut into during the installation of this work must be repaired or replaced with materials of like kind and quality as original materials by skilled labor experienced in that particular building trade.

3.3 FIRESTOPPING

A. Apply firestopping to communications penetrations of fire rated floor and wall assemblies to maintain fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Division 7 section "Firestopping".

3.4 PAINTING

A. Items furnished under this Division that are scratched or marred in shipment or installation shall be refinished with touchup paint selected to match installed equipment finish.

3.5 EQUIPMENT CONNECTION

A. For equipment furnished under this or other Divisions of the specifications, or by owner, provide complete all electrical connections necessary to serve such equipment and provide required control connections to all equipment so that the equipment is fully operational upon completion of the project.

B. Investigate existing equipment to be relocated and provide new connections as required.

C. Obtain rough-in requirements for equipment furnished under other divisions of this specification prior to roughing-in. Review shop drawings and submittals of other Divisions to determine requirements.

3.6 CLEAN UP

A. Contractor shall continually remove debris, cuttings, crates, cartons, etc., created by this work. Such clean up shall be done daily and at sufficient frequency to eliminate hazard to the public, other workers, the building or the Owner's employees. Before acceptance of the installation, Contractor shall carefully clean cabinets, panels, lighting fixtures,

wiring devices, cover plates, etc., to remove dirt, cuttings, paint, plaster, mortar, concrete, etc. Blemishes to finished surfaces of apparatus shall be removed and new finish equal to the original applied.

1. Wipe surfaces of low voltage equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
2. Equipment installed prior to final clean-up shall be cleaned by the contractor. Jacks and patch panels that have construction dirt and dust shall be cleaned to like new condition.

B. Materials recycling and salvage:

1. Recycle all scrap metal.
2. Salvage operable equipment removed from site and deliver to local resale organization.

3.7 TESTING AND DEMONSTRATION

A. Demonstrate that all electrical equipment operates as specified and in accordance with manufacturer's instructions. Perform tests in the presence of the Architect, Owner or Engineer. Provide all instruments, manufacturer's operating instructions and personnel required to conduct the tests. Repair or replace any electrical equipment that fails to operate as specified and or in accordance with manufacturer's requirements.

STANTEC COMMUNICATIONS JOB COMPLETION FORM

PROJECT NAME: OSU Weight Room Refresh
PROJECT LOCATION: Oregon State University
DATE: _____

A. Fire Marshal's Final Acceptance of Fire Alarm System (Copy of certificate attached.)

_____
Name Agency Date

B. The following systems have been demonstrated to Owner's representative.

1. Communications System _____
Owner's Rep. Date

5. Master Antenna Television System _____
Owner's Rep Date

C. Record Drawings
Attached Transmitted previously to _____
Date

D. O & M Manuals
Attached Transmitted previously to _____

E. Test Reports
Attached Transmitted previously to _____
Date

F. The work is complete in accordance with contract documents and authorized changes except for

_____
and the Architect/Engineer's representative is requested to meet with
_____ at _____ on _____
Supervisor of Communications Work Time Date

_____ _____
Contractors Rep. Signature Date

Stantec Schedule of Values for OSU Magruder Expansion

Description of Work	**Amount**
Material and Labor Allowance	
Hangers and Supports - Material & Labor	
Raceways - Conduit - Material & Labor	
Raceways – Cable tray - Material & Labor	
Equipment Racks - Material & Labor	
Rough-in Cabling - Material & Labor	
Install jacks and faceplates - Materials & Labor	
Equipment room terminations - Materials & Labor	
Backbone cabling, Installation & Testing - Materials & Labor	
Horizontal Cable Labeling & Testing - Materials & Labor	
Strap Support Allowance (for existing systems) - Labor & Materials	
Testing, Demonstration (AHJ approvals)	
Training	
Close Out (Record Drawings, O&M, etc.) - Materials & Labor	
TOTAL DIVISION 27	

STANTEC SUBMITTAL LIST OSU Magruder Expansion

SECTION	DESCRIPTION	SUBMIT RECEIVE DATE	STATUS
270526	GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS		
270528	PATHWAYS FOR COMMUNICATIONS SYSTEMS		
270529	HANGERS AND SUPPORTS FOR COMMUNICATION SYSTEMS		
270533	CONDUIT AND BACKBOXES FOR COMMUNICATION SYSTEMS		
270536	CABLE TRAY FOR COMMUNICATION SYSTEMS		
270544	SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING		
271100	COMMUNICATIONS EQUIPMENT ROOM FITTINGS		
271300	COMMUNICATIONS BACKBONE CABLING		
271500	COMMUNICATIONS HORIZONTAL CABLING		

END OF SECTION 27 05 00

SECTION 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Grounding conductors.
2. Grounding connectors.
3. Grounding busbars.
4. Grounding labeling.

1.3 DEFINITIONS

A. BCT: Bonding conductor for telecommunications.

B. EMT: Electrical metallic tubing.

C. PBB: Primary bonding busbar / Telecommunications grounding busbar.

D. SBB: Secondary bonding busbar / Telecommunications main grounding busbar.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For communications equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.

1.5 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:

1. BCT, PBB, SBBs, and routing of their bonding conductors.

B. Qualification Data: For Installer, installation supervisor, and field inspector.

C. Qualification Data: For testing agency and testing agency's field supervisor.

D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Result of the ground-resistance test, measured at the point of BCT connection.

b. Result of the bonding-resistance test at each SBB and its nearest grounding electrode.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Installation Supervision: Installation shall be under the direct supervision of ITS Technician, who shall be present at all times when Work of this Section is performed at Project site.

2. Field Inspector: Currently registered by BICSI as a registered communications distribution designer to perform the on-site inspection.

PART 2 - PRODUCTS

2.1 SYSTEM COMPONENTS

A. Comply with ANSI/TIA-607-C.

2.2 CONDUCTORS

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. Harger Lightning and Grounding.

2. Panduit Corp.

3. Tyco Electronics Corp.

B. Comply with UL 486A-486B.

C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.

1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.

D. 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 kcmils (14.2 sq. mm), 14 strands of No. 17 AWG conductor, and 1/4 inch (6.3 mm) in diameter.

5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

E. Conductor Sizing Table:

Table 1 –TBB conductor size vs length

TBB/GE linear length m (ft)	TBB/GE size (AWG)
less than 4 (13)	6
4 – 6 (14 – 20)	4
6 – 8 (21 – 26)	3
8 – 10 (27 – 33)	2
10 – 13 (34 – 41)	1
13 – 16 (42 – 52)	1/0
16 – 20 (53 – 66)	2/0
20 – 26 (67 – 84)	3/0
26 – 32 (85 – 105)	4/0
32 – 38 (106 – 125)	250 kcmil
38 – 46 (126 – 150)	300 kcmil
46 – 53 (151 – 175)	350 kcmil
53 – 76 (176 – 250)	500 kcmil
76 – 91 (251 – 300)	600 kcmil
Greater than 91 (301)	750 kcmil

2.3 CONNECTORS

A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.

B. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Ortronics

2. No Exceptions Taken.

C. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.

1. Electroplated tinned copper, C and H shaped.

D. Busbar Connectors: Cast silicon bronze, solderless compression or exothermic-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch (15.8- or 25.4-mm) centers for a two-bolt connection to the busbar.

2.4 GROUNDING BUSBARS

A. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with ANSI/TIA J-STD-607-C. Predrilling shall be with holes for use with lugs specified in this Section.

1. Rack-Mounted Horizontal Busbar: Designed for mounting in 19- or 23-inch (483- or 584-mm) equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.

2.5 LABELING

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. Brother International Corporation.
2. Hellermann Tyton.
3. Panduit Corp.
4. SYSTIMAX, A Commscope Company

B. 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.

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.

B. Inspect the test results of the ac grounding system measured at the point of BCT connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.

B. Comply with NECA 1.

C. Comply with ANSI/TIA-607-C.

3.3 APPLICATION

A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

1. The bonding conductors between the SBB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2 AWG minimum.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Connections to Structural Steel: Welded connectors.

D. Conductor Support:

1. Secure grounding and bonding conductors at intervals of not less than 36 inches (900 mm.)

E. Grounding and Bonding Conductors:

1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
2. Install without splices.
3. Support at not more than 36-inch (900-mm) intervals.
4. Install grounding and bonding conductors in 3/4-inch (21-mm) PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
    a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a SBB.

3.4 CONNECTIONS

A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.

B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.

C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:

1. Use crimping tool and the die specific to the connector.
2. Pretwist the conductor.
3. Apply an antioxidant compound to all bolted and compression connections.

D. Interconnections: Interconnect SBB with the existing PBB with the telecommunications backbone conductor. The telecommunications backbone conductor and grounding equalizer conductor shall be sized according to the distance between the two devices and according to the Conductor Sizing Table shown above in 2.2.F.

E. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install top-mounted or vertically mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the SBB No. 2 AWG bonding conductors.

F. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each SBB and PBB to the vertical steel of the building frame.

G. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each SBB to the ground bar of the panelboard.

H. Shielded Cable: Bond the shield of shielded cable to the SBB in communications rooms and spaces. Comply with TIA/EIA-568-C when grounding screened, balanced, twisted-pair cables.

I. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.

3.5 IDENTIFICATION

A. Labels shall be preprinted or computer-printed type.

1. Label SBB(s) with "fs-SBB," where "fs" is the telecommunications space identifier for the space containing the SBB.

2. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a PBB and a SBB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.

a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.

3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.

a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the PBB and in each SBB. Maximum acceptable ac current level is 1 A.

D. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 27 05 26

SECTION 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 270500 – Common Work Results for Communications apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Optical-fiber-cable pathways and fittings.
4. Metal wireways and auxiliary gutters.
5. Nonmetallic wireways and auxiliary gutters.
6. Surface pathways.
7. Boxes, enclosures, and cabinets.

B. Related Requirements:

1. Section 270533 "Conduits and Backboxes for Communications Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

D. EMT: Electrical metallic tubing

E. PVC: Polyvinyl Chloride

F. RNC: Rigid non-metallic conduit

G. HDPE: High-density polyethylene

H. RTRC: Reinforced thermosetting resin conduit

1.4 ACTION SUBMITTALS

A. Product Data: For surface pathways, 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.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Pathway 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 pathway 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 pathway racks, enclosures, cabinets, equipment 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 certification is based and their installation requirements.
4. Detailed description of conduit support devices and interconnections on which certification is based and their installation requirements.

D. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND 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. AFC Cable Systems, Inc.
2. Allied Tube & Conduit; a Tyco International Ltd. Co.
3. Electri-Flex Company.
4. O-Z/Gedney; a brand of EGS Electrical Group.
5. Southwire Company.
6. Thomas & Betts Corporation.
7. Or approved equal.

B. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-D.

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. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:
   a. Material: Steel.
   b. Type: compression.
3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, 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.

2.2 NONMETALLIC CONDUITS AND 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. AFC Cable Systems, Inc.
2. Allied Tube & Conduit; a Tyco International Ltd. Co.
3. Electri-Flex Company.
4. Lamson & Sessions; Carlon Electrical Products.
5. RACO; a Hubbell company.
6. Thomas & Betts Corporation.
7. Or approved equal.

B. General Requirements for Nonmetallic Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-D.

C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. Rigid HDPE: Comply with UL 651A.

E. Continuous HDPE: Comply with UL 651B.

F. RTRC: Comply with UL 1684A and NEMA TC 14.

G. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

H. 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).

2.3 OPTICAL FIBER CABLE PATHWAYS AND 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. Alpha Wire Company.
2. Arnco Corporation.
3. Endot Industries Inc.
4. IPEX.
5. Lamson & Sessions; Carlon Electrical Products.
6. Maxcell Fabric Innerduct
7. Or approved equal.

B. Description: Comply with UL 2024; flexible-type pathway, approved for plenum installation unless otherwise indicated.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-D.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Hoffman, a Pentair Company
2. Hubbell Incorporated; Killark Division.
3. Lamson & Sessions; Carlon Electrical Products
4. O-Z/Gedney; a brand of EGS Electrical Group.
5. RACO; a Hubbell Company
6. Thomas & Betts Corporation.
7. Wiremold/Legrand.
8. Or approved equal.

B. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with TIA-569-D.
2. 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. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

F. Metal Floor Boxes:

1. Refer to Section 260533.10 for floor boxes.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

I. Device Box Dimensions: 4-11/16 inches square by 2-1/8 inches deep (119 mm square by 60 mm deep).

J. Gangable boxes are allowed.

K. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT or RNC.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Concealed in Ceilings and Interior Walls and Partitions: EMT or innerduct.
4. Damp or Wet Locations: GRC.
5. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway or EMT with innerduct.
6. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: [Riser-type, optical-fiber-cable pathway or EMT with innerduct.
7. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: EMT.
8. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

B. Minimum Pathway Size: 1-inch (27 mm) trade size. Minimum size for optical-fiber cables is 1- inch (27 mm).

C. Pathway Fittings: Compatible with pathways 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. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.

D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

E. Install surface pathways only where indicated on Drawings.

F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.2 INSTALLATION

A. Comply with NECA 1, NECA 101, and TIA-569-D for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

B. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

C. Complete pathway installation before starting conductor installation.

D. Comply with requirements in Section 270529 "Hangers and Supports for Communications 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 two 90-degree bends in any pathway run. Support within 12 inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.

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. Pathways 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 pathways to reinforcement at maximum 10-foot (3-m) intervals.

2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.

3. Arrange pathways to keep a minimum of 1 inch (25 mm) of concrete cover in all directions.

4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

J. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for pathways.

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 pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

N. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

O. 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.

P. Cut conduit perpendicular to the length. For conduits of 2-inch (53-mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

Q. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.

R. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch (21-mm) Trade Size and Smaller: Install pathways in maximum lengths of 50 feet (15 m).

2. 1-Inch (27-mm) Trade Size and Larger: Install pathways in maximum lengths of 75 feet (23 m).

3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

S. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, 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 pathway sealing fittings according to NFPA 70.

T. Install devices to seal pathway 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 pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where an underground service pathway enters a building or structure.

3. Where otherwise required by NFPA 70.

U. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

V. 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.

W. 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 surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

X. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

Y. 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.

Z. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

AA. Set metal floor boxes level and flush with finished floor surface.

BB. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage or 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 27 05 28

SECTION 27 05 29 - HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

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.

B. Section 270500 - Common Work Results for Communications

1.2 SUMMARY

A. Section includes discrete J-hooks, slings and related accessories for supporting communications and other low voltage cables above accessible ceilings and below accessible raised floor systems.

1.3 REFERENCES

A. As indicated in Section 270500.

1.4 SUBMITTALS

A. Provide submittal information in accordance with Division 01 – General Requirements and supplementary requirements described in this specification.

B. Product Data: Provide the following:

1. Product data on all cable support devices and accessories. Indicate materials, finishes, load ratings, dimensions, listings, approvals and attachment methods.

C. Shop Drawings: For projects where the low voltage systems cable pathways are not shown on the drawings, they are to be contractor designed per Part 3. The contractor shall prepare and submit proposed main pathway (20 cables or more), layout drawings for review and approval by the Owner's representative prior to installing supports. Shop drawings shall:

1. Indicate pathways on plan view showing pathway coordination with mechanical components, lighting components, sprinkler head components, plumbing components and electrical components
2. Include elevations and sections to indicate space allocations and coordination with work of other trades
3. Include details to describe the different support configurations, accessories, attaching means and cable groupings

D. Closeout Submittals – In accordance with section 270500.

1.5 QUALITY ASSURANCE

A. Hangers, supports and accessories shall be listed to Underwriter's Laboratories, Inc Standard 2239.

B. Pre-Installation Meetings: Contractor shall set up a pre-installation meeting to discuss communication and other low voltage cable support layout work and installation guidelines. Contractor shall organize meeting a minimum of 30 days prior to initiating hangars and support installation work. Attendees shall include general contractor, cable tray contractor, cable contractor(s), mechanical contractor, sprinkler contractor low voltage system vendors, Architect and Engineer. Purpose of meeting shall be to coordinate work between the parties to have a consistent layout for all communications and low voltage system cables, minimize interferences and to make cable system accessibility for future Owner modifications and maintenance high priority issue for all installers.

1.6 COORDINATION

A. Coordinate as required in section 270500.

B. Examine drawings and existing conditions above ceilings and include additional supports in bid price to avoid ducts, pipes, conduits, etc. Installation in existing ceilings if very difficult. Include extra labor time involved in bid price.

PART 2 - PRODUCTS

2.1 WIDE BASE CABLE SUPPORTS

A. J-hooks - Galvanized loop with integrated cable retainers, complies with TIA structured cabling system requirements, as indicated in section 270500.

B. Accessories: Provide applicable accessories to independently support J- hooks from structure. This includes extender bracket for mounting multiple J-hooks on a single support, fasteners and clamps for connecting to wall, beams, rods, dedicated support wires and *C* and *Z* Purlins as required for specific construction.

C. Manufacturer.

1. ERICO Caddy CableCat™ series
2. Chatsworth RapidTrak™ series
3. Or approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Support all cables not supported in conduits and cable tray with J-Hooks or slings. Space J-Hooks or slings at a maximum of 48-inches apart and at each change of direction of the cables. Maintain maximum sag of 12-inches between supports

B. Install supports to route cables parallel and perpendicular to building lines. Hang cable supports from 3/8" all thread rods, dedicated #8 galvanized ceiling drop wire or wall brackets connected directly to structure. Do not support from the ceiling grid or ceiling wire system.

C. Provide the appropriate sized J- hooks as required. Minimum 1" width and flared edges where cables enter and leave support. 2-inch diameter loop for (25) 4-pair UTP cables and 4-inch diameter loop for (50) 4-pair UTP cables.

D. Provide multiple hooks at each hanger location as required by cable count and cable segregation requirements.

E. Install cable bundles no closer than 5-inches in all directions from ballasted light fixtures.

F. Where main pathways are indicated on the drawings, contractor shall follow indicated pathway as closely as possible according to field conditions. Pathway for smaller cable counts shall be laid out and documented on the as-built drawings by the contractor.

G. Where specific main pathways are not indicated, the cable pathways for all communication systems shall be laid out by the contractor and coordinated with other disciplines and the systems designer.

H. Do not tie wrap cables to the J-hooks. Provide cable retainers at each J-hook.

I. Provide applicable accessories to independently support J-hooks from structure, including extender bracket for mounting multiple J hooks on a single support, fasteners and clamps for connecting to wall, beams, rods, dedicated support wires and *C* and *Z* Purlins as required for specific construction.

J. At a minimum, brace multiple J-hook assemblies from structure with diagonal braces at each change of direction.

K. Coordinate the allocation of ceiling space and the mounting elevations of various systems to allow maintenance and accessibility for future modifications. Cable supports shall be as close to the ceiling as possible while allowing ceiling tiles to be removed. Supports shall be located to avoid interference with maintenance access to other equipment.

END OF SECTION 27 05 29

SECTION 27 05 33 - CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections, and Section 270500 - Common Work Results for Communications apply to this Section.

B. Other References

TIA-569-D	Commercial Building Standard for Telecommunications Pathways and Spaces
ANSI/TIA-607-C	Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

1.2 DESCRIPTION

A. Provide raceway systems for the installation of the communications cabling. Installation shall include raceways, outlet boxes, mud rings, outlet box cover plates and terminal back boards.

1.3 SUBMITTALS

A. Provide submittal information in accordance with Division 01 and supplementary requirements described in this specification.

B. Product Data: Provide the following:

1. Product data on all cable support devices and accessories. Indicate materials, finishes, load ratings, dimensions, listings, approvals and attachment methods.

C. Shop Drawings: For projects where the low voltage systems cable pathways are not shown on the drawings, they are to be contractor designed per Part 3. The contractor shall prepare and submit proposed main pathway (defined as 20 Category 6 cables or more), layout drawings for review and approval by the Owner's representative prior to installing supports. Shop drawings shall:

1. Indicate pathways on plan view showing pathway coordination with mechanical components, lighting components, sprinkler head components, plumbing components and electrical components
2. Include elevations and sections to indicate space allocations and coordination with work of other trades
3. Include details to describe the different support configurations, accessories, attaching means and cable groupings

D. Closeout Submittals – In accordance with section 270500

PART 2 - PRODUCTS

2.1 WALL OUTLETS

A. Shall consist of a 4-11/16" square, 2-1/8" deep (minimum) box, with knockouts for 3/4", 1", and 1-1/4" conduits, as manufactured by Steel City, OZ/Gedney or equal.

B. Surface wall outlets shall be 4" square, 2-3/4" deep (minimum) and shall match and be manufactured by the surface metal raceway manufacturer.

2.2 FLOOR OUTLETS

A. See Section 260533.10 - Flush Floor Outlets for flush floor outlets.

2.3 OUTLET DEVICE RING

A. Provide single gang device ring.

B. Device rings shall be by the same manufacturer as the outlet boxes.

2.4 DEVICE PLATES

A. Provide blank device cover plates for all un-cabled or "future" outlets.

2.5 PULL WIRE

A. Shall be nylon having not less than 200-pound tensile strength.

PART 3 - EXECUTION

3.1 WALL OUTLETS IN WALLS WITH ACCESSIBLE CEILINGS

A. Provide a minimum 1” individual conduit from each outlet location to an accessible ceiling space. Provide non-metallic conduit bushing prior to cable installation.

3.2 WALL OUTLETS IN WALLS WITH NON-ACCESSIBLE CEILINGS

A. Provide an individual conduit from each outlet location to an accessible ceiling space. Provide non-metallic conduit bushing prior to cable installation.

3.3 FLOOR MOUNTED OUTLETS

A. All conduits from floor outlets shall terminate in a space on the same floor as the outlet.

B. Provide an individual 1-1/4” conduit from each outlet location to an accessible ceiling space.

3.4 FLOOR OUTLETS/ BOXES IN SLAB ON GRADE

A. Provide an individual conduit from each outlet box to a consolidation point interior to the building within 25 feet of the point where the conduit exits the slab.

B. Provide an individual conduit from each outlet box to the serving communications room.

3.5 CONDUIT SIZING TABLE

A. Provide conduits for communications outlets sized as follows:

Wall Phones	1"
Wall Outlets (except wall phones)	1"
Single Gang Floor Mounted Outlets/Boxes	1-1/4”"
Multiple Gang Recessed Floor Outlets/Boxes	1-1/4"

3.6 RACEWAYS

A. Shall conform to specification as outlined in section 1.1, and Division 27 related sections - with the additional requirement that no length of run shall exceed 100 feet and shall not contain more than two 90-degree bends or the equivalent without a code size pull box sized per Pull Box Sizing table below. Provide pull boxes where necessary to comply with these requirements. Locate pull boxes in straight runs only, not as a replacement for an elbow.

B. Conduits with an internal diameter of two inches or less shall have a bend radius at least 6 times the internal conduit diameter. Conduits greater than two inches shall have a bend radius at least 10 times the internal conduit diameter.

C. Provide an insulated bushing on all conduits terminated in an enclosure, prior to cable installation.

D. Terminate conduits stubbed out above accessible ceiling space so that the conduit is parallel with the ceiling and provide an insulating bushing, prior to cable installation.

Terminate conduit at cable trays at an accessible location within 6" of tray with an insulated bushing and provide bonding jumper or terminate conduit to the cable tray with an insulated bushing. Provide insulated bushing on conduits prior to cable installation.

3.7 PULL BOXES

A. Pull boxes shall be sized per the following table:

PULL BOX SIZING (inches)

Conduit Trade Size	Width	Length	Depth	Width increase for additional conduit
1	4	16	3	2
1-1/4	6	20	3	3
1-1/2	8	27	4	4
2	8	36	4	5
2-1/2	10	42	5	6
3	12	48	5	6

3.8 PULL CORDS

A. Nylon type pull cords shall be included in all raceways over 10 feet long. Leave not less than 12 inches of slack at each end of the pull wire.

3.9 RACEWAY RISER SLEEVES

A. Riser raceways to be installed through floors with tops 6 inches above each floor to give continuous cable riser capability. Provide Firestopping to meet requirements of Division 01.

3.10 REMODEL SPACES

A. Remove in-active and abandoned communications cabling that serve spaces remodeled, only after receiving approval from the Owner.

B. Notify Owner in writing when active telephone and computer conductors serving occupied spaces must be relocated due to the remodel.

END OF SECTION 27 05 33

SECTION 27 05 44 - SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 270500 - Common Work Results for Communications

1.2 SUMMARY

A. Section Includes:

1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 SUBMITTALS

A. Provide submittal information in accordance with Division 01 and supplementary requirements described in this specification.

B. Product Data: For each type of product.

C. LEED Submittals:

1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit EQ 4: For sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Closeout Submittals – In accordance with section 270500

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.

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-steel sheet.

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).

b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.

1. Manufacturers: Subject 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. 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: Carbon steel.

4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.3 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Presealed Systems.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors. Grout shall not be used to firestop communications conduits.

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.

2.5 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 250 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, non-shrinking foam.

PART 3 - EXECUTION

3.1 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 pathway 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 pathway 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 pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel cast-iron 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 cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 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 27 05 44

SECTION 27 15 00 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 270500 - Common Work Results for Communications

1.2 SUMMARY

A. Section Includes:

1. UTP cabling.
2. Coaxial cable.
3. Cable connecting hardware, patch panels, and cross-connects.
4. Telecommunications faceplates.
5. Cabling system identification products.
6. Cable management system.

B. Related Requirements:

1. Section 280513 "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.

C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

D. EMI: Electromagnetic interference.

E. IDC: Insulation displacement connector.

F. LAN: Local area network.

G. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

H. RCDD: Registered Communications Distribution Designer.

I. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate layout and installation of telecommunications 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.

1.5 SUBMITTALS

A. Provide submittal information in accordance with Section 270500 - Common Work Results For Communications and supplementary requirements described in this specification.

B. Product Data: For each type of product.

1. Provide submittals as required in section 270500.

C. Shop Drawings:

1. Provide shop drawings as required in section 270500.

1.6 CLOSEOUT SUBMITTALS

A. Closeout Submittals – In accordance with section 270500.

1.7 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. Patch-Panel Units: One of each type.

2. Connecting Blocks: One of each type.

3. Device Plates: One of each type.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.

2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.

B. Testing Agency Qualifications: An NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cables to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set.

2. Test optical fiber cables while on reels. Use an optical time domain reflectometer (OTDR) to verify the cable length and locate cable defects, splices, and connector; including the loss value of each. Retain test data and include the record in maintenance data.

3. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.1 HORIZONTAL CABLING DESCRIPTION

A. Horizontal (workstation) Cabling System shall consist of a minimum of (2) Category 6, 4-pair unshielded twisted pair (UTP) copper cables to each work area outlets in office locations.

B. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.

1. TIA/EIA-568-C.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.

2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.

3. Bridged taps and splices shall not be installed in the horizontal cabling.

4. Splitters shall not be installed as part of the optical fiber cabling.

C. A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the telecommunications outlet/connectors to the station equipment.

D. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment or in the horizontal cross-connect.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-C.1 when tested according to test procedures of this standard.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.

2. Smoke-Developed Index: 50 or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Grounding: Comply with ANSI/TIA J-STD-607-C.

2.3 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Superior Essex Inc., Part number: DataGAIN Cat 6

2. No Exceptions Taken.

B. Description: 100-ohm, four-pair UTP, covered with a green (Data) or grey (Voice) thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.

2. Comply with TIA/EIA-568-C.1 for performance specifications.

3. Comply with TIA/EIA-568-C.2, Category 3 and Category 6.

4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

a. Communications, Plenum Rated: Type CMP or MPP, complying with NFPA 262.

2.4 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Ortronics

2. No Exceptions Taken.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-C.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 110-style IDC for Category 6**.** Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. 110- Termination Block Wiring Troughs: horizontal trough for routing of patch cords and cross-connect wire, with mounting legs:

1. Ortronics, Part Number: OR-30200140

2. No Exceptions Taken.

E. 110-block labels (Cat 3): clear plastic holder for 110-blocks with paper inserts, for blocks with legs:

1. Ortronics OR-70400646

2. Ortronics OR-70400680.

3. No Exceptions Taken.

F. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables.

G. Patch Panel: Category 6 modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables. Number of Jacks per Field: One for each four-pair UTP cable indicated.

1. Ortronics Angled OR-PHA66U48.

2. No Exceptions Taken.

H. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

1. Ortronics voice: Part number OR-6373003, Fog White
2. Ortronics data: Part Number OR TJ600-25, Green
3. No Exceptions Taken.

I. Patch Cords: Factory-made, four-pair; terminated with eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
2. Patch cords shall have color-coded boots for circuit identification.

3. Provide patch cords for 100% of installed cables. Coordinate exact length with OSU IT services.

a. Ortronics OR-MC6xx-05, Green CAT6 for work area outlets.

b. Ortronics OR-MC61xxx-07, Purple CAT6A for wireless access points.

2.5 TELECOMMUNICATIONS OUTLET FACEPLATES

A. Workstation Outlets:

1. 6-port-connector assemblies mounted in single TracJack faceplate constructed from high impact thermoplastic, with recessed label fields. Coordinate color with Section 262726 "Wiring Devices."

a. Part Number: Ortronics OR-40300545, fog white.

b. No Exceptions Taken.

2. 1-port TracJack faceplate with mounting lugs for wall phone, constructed from stainless steel, mounts within a single gang wall box, RJ45.

a. Part Number: Ortronics OR-403STJ1WP

b. No Exceptions Taken.

3. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.

4. Legend: Machine printed, in the field, using adhesive-tape label.

5. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

B. Dust Covers: Single port dust cover for modular openings, color to match faceplate.

1. Part Number: Ortronics OR-42100002, fog white.

2. No Exceptions Taken.

2.6 GROUNDING

A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

C. Comply with ANSI/TIA-607-C.

2.7 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-B and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Section 260553 "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal pathways and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

2. Comply with requirements in Section 270528 "Pathways for Communications Systems."

3. Comply with requirements in Section 270536 "Cable Trays for Communications Systems."

B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

2. Install lacing bars and distribution spools.

3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.2 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-C.1.

2. Comply with BICSI ITSIM, "Cable Termination Practices."

3. Install 110-style IDC termination hardware unless otherwise indicated.

4. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panel

5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.

8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
10. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.

11. Pulling Cable: Comply with BICSI ITSIM, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-C.2.

2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

3. Install and leave in place 1/8” nylon pull cord with all cable installed in conduit.

D. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-C.3.

2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 48 inches (1219 mm) apart.

3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Installation of Cable Routed in Wet Listed locations:

1. Install outdoor or outdoor/indoor rated cable only.

2. Cables must be transitioned from outdoor rated cabling to indoor rated cabling in a consolidation point or terminate on equipment within 50-feet of entering the building.

G. Group connecting hardware for cables into separate logical fields.

H. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-D for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: No requirement.

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).

6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.3 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.4 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI/TIA-607-C.

C. Comply with Section 260526 “Grounding and Bonding for Electrical Systems”.

D. Comply with Section 270526 “Grounding and Bonding for Communications Systems”.

3.5 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-B. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Administration Class: 3.

2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.

C. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-B for Class 3 level of administration, including optional identification requirements of this standard.

E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-B. Furnish electronic record of all drawings, in software and format selected by Owner.

G. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.

3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).

4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

   a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.

   b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-B.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will 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. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-C.1.

2. Visually confirm Category 3, Category 6**,** marking of outlets, cover plates, outlet/connectors, and patch panels.

3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

   a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-C.2. Perform tests with a tester that complies with performance requirements in

"Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

5. Optical Fiber Cable Tests:

   a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

   b. Link End-to-End Attenuation Tests:

      1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA-526-14-C, Method B, One Reference Jumper.

      2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-C.1.

6. UTP Performance Tests:

   a. Test for each outlet. Perform the following tests according to TIA/EIA-568-C.1 and TIA/EIA-568-C.2:

      1) Wire map.

      2) Length (physical vs. electrical, and length requirements).

      3) Insertion loss.

      4) Near-end crosstalk (NEXT) loss.

      5) Power sum near-end crosstalk (PSNEXT) loss.

      6) Equal-level far-end crosstalk (ELFEXT).

      7) Power sum equal-level far-end crosstalk (PSELFEXT).

      8) Return loss.

      9) Propagation delay.

      10) Delay skew.

   b. All test results will provide for 5dB of headroom (NEXT) as per the nCompass 6+ Solution guarantee.

   c. All test results shall be provided in the approved certification testers original software format on a CD, with the following minimum information per cable:

      1) Circuit ID

      2) All information from C.6.a above.

      3) Test result, "Pass" or "Fail"

      4) Date and Time of test

      5) Project Name

      6) NVP

7) Version of software

8) Note: No asterisk will be accepted by Ortronics. These results shall be retested and submitted after a "Pass" is received.

7. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA/EIA-568-B.1 and TIA/EIA-568-C.3.
8. Coaxial Cable Tests: Conduct tests according to Section 274133 "Master Antenna Television System."
9. Final Verification Tests: Perform verification tests for UTP and optical fiber systems after the complete communications cabling and workstation outlet/connectors are installed.

   a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.

   b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.7 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 operating system. 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.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets. Include training in cabling administration software.

END OF SECTION 27 15 00

SECTION 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

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 general electrical requirements for all Division 28 work and is supplemental and in addition to the requirements of Division 01.

B. It is the intention of this Division of the Specifications and the Contract Drawings to describe and provide for the furnishing, installing, testing and placing in satisfactory and fully operational condition all equipment, materials, devices and necessary appurtenances to provide a complete electrical system. Provide all materials, appliances and apparatus not specifically mentioned herein or shown on the drawings, but which are necessary to make a complete, fully operational installation of all electrical systems shown on the contract drawings or described herein. Connect equipment and devices furnished and installed under other Divisions of this specification (or the Owner) under this Division.

C. Workmanship shall be of the best quality and competent and experienced electricians shall be employed and shall be under the supervision of a competent and experienced foreman.

D. The drawings and specifications are complimentary and what is called for (or shown) in either is required to be provided as if called for in both.

1.3 WORK IN OTHER DIVISIONS

A. Refer to Division 27 for Communications and Division 28 for Electronic Safety and Security. System elements of those Divisions require conformance and integration with the work of Division 26.

B. See all other specifications for other work which includes but is not limited to:

Cutting and Patching

Door Hardware

Fire Protection

Mechanical Systems and Control Wiring

Painting, Refinishing and Finishes

1.4 CODES, PERMITS, INSPECTION FEES

A. The following codes and standards are referenced in the Division 28 specifications. Perform all work and provide materials and equipment in accordance with the latest referenced codes and standards of the following organizations:

1. American National Standards Institute (ANSI)
2. National Electrical Manufacturer's Association (NEMA)
3. National Fire Protection Association (NFPA)
4. Underwriter's Laboratories (UL)
5. NECA National Electrical Contractor's Associaton

B. Install the electrical systems based on the following:

NFPA 70	National Electrical Code as adopted and amended by the Local Jurisdiction.
IBC	International Building Code as adopted and amended by the Local Jurisdiction.

C. The referenced codes establish a minimum level of requirements. Where provision of the various codes conflict with each other, the more stringent provision shall govern. If any conflict occurs between referenced codes and this specification, the codes are to govern. Compliance with code requirements shall not be construed as relieving the Contractor from complying with any requirements of the drawings or specifications which may be in excess of requirements of the governing codes and rules and not contrary to same.

D. Obtain and pay for all licenses, permits and inspections required by laws, ordinances and rules governing work specified herein. Arrange for inspection of work by the inspectors and give the inspectors all necessary assistance in their work of inspection.

1.5 COORDINATION

A. Coordination during the bidding and pricing aspects of the contract includes determining where the work of other Divisions relies on the work of this Division for electricity and including the electrical system to match the requirements.

B. Coordinate work with that of the other Contractors and/or other trades doing work on the project. Examine all drawings and specifications of other trades for construction details and coordination. Make every reasonable effort to provide timely notice of work affecting other trades to prevent conflicts or interference as to space requirements, dimensions, openings, block-outs, sleeving or other matters which will cause delays or necessitate work-around methods.

C. Obtain submittals and shop drawings of all equipment with electronic safety and security connections furnished under other divisions of the specification and by the Owner.

D. Provide all wiring in accordance with specific equipment requirements.

E. Immediately advise the Architect of any changes which may affect the contract price.

F. Special attention is called to the following items. Coordinate all conflicts prior to installation:

1. Location of grilles, pipes, sprinkler heads, ducts and other mechanical equipment so that all outlets and other equipment is clear from and in proper relation to these items.

2. Location of cabinets, counters and doors so that electrical outlets and equipment are clear from and in proper relation to these items.

3. Recessing and concealing electrical materials in CMU walls, concrete construction and precast construction.

G. Furnish, install and place in satisfactory condition all raceways, boxes, conductors and connections and all other materials required for the electronic safety and security systems shown or noted in the contract documents to be complete, fully operational and fully tested upon completion of the project. Raceways, boxes and ground connections are shown diagrammatically only and indicate the general character and approximate location. The layout does not necessarily show the total number of raceways or boxes for the circuits required, nor are the locations of indicated runs intended to show the actual routing of the raceways.

H. Consult the architectural drawings for the exact height and location of all electrical equipment not specified herein or shown on the drawings. Make any minor changes (less than 6'-6" horizontal) in the location of the raceways, outlets, boxes, devices, wiring, etc., from those shown on the drawings without extra charge, where coordination requires or if so directed by the Architect before rough-in.

I. Review system product requirements for outlet boxes prior to roughing in. Where product requirements exceed the requirements of other aspects of this specification, increase the outlet box size to match system requirements. Notify Architect prior to installation if conflicts occur between required box depth and wall thickness.

J. Provide inserts or sleeves for outlet boxes, conductors, cables and/or raceways as required. Coordinate the installation thereof with other trades.

K. The Contractor will not be paid for relocation of work, cuttings, patching and finishing required for work requiring reinstallation due to lack of coordination prior to installation.

1.6 WARRANTY

A. Refer to General Conditions of the Contract.

1.7 CORRECTION OF WORK

A. Within one year after the date of Substantial Completion of the work, the Contractor shall correct any work found to be not in conformance with the Contract Documents promptly after written notice from the owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. This obligation shall survive acceptance of the work under this Contract and termination of the Contract. The Owner shall give such notice promptly after discovery of the condition.

1.8 ITEMIZED SCHEDULE OF COSTS

A. Complete the Schedule of Values included at the end of this section. This schedule shall be adhered to for the electrical contractor to facilitate analysis and approval of the monthly progress billings. Refer to the Supplementary Conditions of General Contract and Division 1 - General Requirements for details, and conform thereto.

1.9 SUBMITTALS AND SHOP DRAWINGS

A. Submittals shall show:

1. Indicate listing by UL or other approved testing agency.
2. Highlight with yellow or blue marker adequate information to demonstrate materials being submitted fully comply with contract documents.
3. Review and check all material prior to submittal and stamp "Reviewed and Approved".

B. Shop drawings shall show:

1. Ratings of items and systems.
2. How the components of an item or system are assembled, interconnected, function together and how they will be installed on the project.
3. System layout floor plans with complete device layout, point-to-point wiring connection between all components of the system, wire sizes and color coding.
4. Riser diagrams showing vertical wiring between components.
5. Line diagrams and or logical/control schematics including interface to other systems as applicable. Provide point to point wiring diagrams, indicate terminal identification at item of equipment. Typical diagrams may be used when accompanied by wire schedules that are specific to each product.
6. Coordinate with other division shop drawings and submittals. Identify interface points and indicate method of connection.

1.10 PROJECT CLOSE-OUT

A. Coordinate with close-out provisions in Division 01 - General Requirements.

B. Request For Final Punchlist

1. To request a final electrical punch list, forward a letter to the Architect stating; "The electrical work on this project is complete, all punch list items to date are complete, items a. - i. in the Punchlist Procure paragraph in Section 280500 - Common Work Results For Electronic Safety and Security are complete and the project is ready for final punch list observation."
2. Project Punchlist Procedure: Perform the following procedures for project closeout of electrical portions of work.
    a. Provide engraved nameplates on equipment.
    b. Refinish equipment finishes which are damaged.
    c. Obtain final electrical permit inspection. Include copies in O & M manual.
    d. Provide written warranty in O & M per the General Conditions of the Contract.
    e. Furnish Record Drawings per this section. Obtain signature on Job Completion Form.
    f. Furnish O & M Manuals per this section. Obtain signature on Job Completion Form.

g. Give instruction periods to owner's personnel per this section. Obtain signature on Job Completion Form.

h. To request final acceptance of project, fill out Job Completion Form in this section and forward to the Architect. Note: If inspectors have not signed form, a copy of signed-off permits will suffice.

i. Include with Job Completion Form, a copy of the final punch list with the word "DONE", and the date and Contractor's initials after each item on the list.

1.11 ELECTRICAL EQUIPMENT OPERATION AND MAINTENANCE (O&M) MANUALS

A. Provide O&M manuals required in Division 01 - General Requirements for all equipment furnished under Division 28 - Electronic Safety and Security specifications.

B. The information included must be the exact equipment installed. Where sheets show the equipment installed and other equipment, the installed equipment shall be neatly and clearly identified on such sheets.

C. These O&M manuals shall contain all the information needed to operate and maintain all systems and equipment provided in the project. Present and arrange information in a logical manner for efficient use by the Owner's security and operating personnel. The information provided shall include but not be limited to the following:

1. Equipment manufacturer, make, model number, size, nameplate data, etc.
2. Description of system configuration and operation including component identification and interrelations. A master control schematic drawings(s) may be required for this purpose.
3. Dimensional and performance data for specific unit provided as appropriate.
4. Manufacturer's recommended operation instructions.
5. Manufacturer's recommended preventative maintenance program and service instructions for the system as a whole and for each component, function, and operation in detail.
6. Complete parts list including reordering information, recommended spares and anticipated useful life (if appropriate). Parts lists shall give full ordering information assigned by the original parts manufacturer. Relabeled and/or renumbered parts information as reassigned by equipment supplier not acceptable.
7. Shop drawings.
8. Wiring diagrams.
9. Signal equipment submittals shall contain step-by-step circuit description information designed to acquaint maintenance personnel with equipment operation in each mode of operation.
10. A complete list of local (nearest) manufacturer representative and distributor contacts for each type of equipment and manufacturer. Include name, company, address, phone, fax, e-mail address, and web site.

11. Trouble-shooting guide for each system including a list of troubles, causes, and recommended remedies.

12. A recommended spare parts list for owner consideration.

D. Furnish complete wiring diagrams for each system for the specific system installed under the contract. "Typical" line diagrams will not be acceptable unless revised to indicate the exact field installation.

E. Group the information contained in the manuals in an orderly arrangement by specification index. Provide a typewritten index and divider sheets between categories with identifying tabs. Bind the completed manuals with hard board covers not exceeding 5" thick. (Provide two or more volumes if required.) Signal and communication systems shall be in separate volumes. Imprint the covers with the name of the job, Owner, Architect, Electrical Engineer, Contractor and year of completion. Imprint the back edge with the name of the job, Owner and year of completion. Hard board covers and literature contained may be held together with screw post binding.

1.12 INSTRUCTION PERIODS

A. After substantial completion of the work and 20 days after the O&M manuals have been delivered to the owner and after all tests and final inspection of the work by the Authority(s) Having Jurisdiction; demonstrate the electrical systems and instruct the Owner's designated operating and maintenance personnel in the operation and maintenance of the various electrical systems. The Contractor shall arrange scheduled instruction periods with the Owner. The Contractor's representatives shall be superintendents or foremen knowledgeable in each system and suppliers representatives when so specified. When more than one training session is specified, the second session shall be 30 to 90 days after the first as agreed to by the Owner.

B. Include in each instruction session an overview of the system, presentation of information in maintenance manuals with appropriate references to drawings. Conduct tours of the building areas with explanations of maintenance requirements, access methods, servicing and maintenance procedures, equipment cleaning procedures and adjustment locations.

C. Include the following scheduled instruction periods. Reference other Division 28 Specification Sections as noted:

		1st Session	2nd Session
1	Fire Detection and Alarm	2 hours	2 hours

D. Manufacture certified representatives shall provide instruction for each of the sessions listed above.

E. Provide one professionally produced digitally recorded or video tape of each training session in DVC. Furnish two (2) copies to the owner.

1.13 RECORD DRAWINGS

A. Continually record the actual electrical system(s) installation on a set of prints kept readily available at the project during construction. These prints shall be used for this purpose alone.

1. Mark record prints with red erasable pencil. Mark the set to show the actual installation where the installation varies substantially from the work as originally shown.
2. Accurately locate with exact dimensions all underground and underslab raceways and stub-outs.
3. Note changes of directions and locations, by dimensions and elevations, as utilities are actually installed.
4. Include addenda items and revisions made during construction.
5. Erase conditions not constructed or "X-out" and annotate "not constructed" to clearly convey the actual "as constructed" condition.

1.14 FINAL ACCEPTANCE REQUEST

A. Comply with Division 01.

1.15 ABBREVIATIONS AND DEFINITIONS

A. When the following abbreviations and definitions are used in relation to the work for Division 28 they shall have the following meanings:

Item	Meaning
AHJ	Authority Having Jurisdiction.
Boxes	Outlet, Junction or Pull Boxes.
Code	All applicable codes currently enforced at project location.
Compression	Compressed using a leverage powered (hydraulic or equivalent) crimping tool.
Connection	All materials and labor required for equipment to be fully operational.
Exterior Location	Outside of or penetrating the outer surfaces of the building weather protective membrane.
Fully Operational	Tested, approved, and operating to the satisfaction of the AHJ, manufacturer and contract documents.
Furnish	Deliver to the jobsite
Install	To enter permanently into the project and make fully operational.
Kcml	Thousand circular mils (formerly MCM).
Mfr.	Manufacturer.
NEC	National Electrical Code, National Fire Protection Association, Publication #70.
Noted	Shown or specified in the contract documents.
Provide	Furnish and install.
Required	As required by code, AHJ, contract documents, or manufacturer for the particular installation to be fully operational.
Shown	As indicated on the drawings or details.
Wiring	Raceway, conductors and connections.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment installed shall have been tested and listed by Underwriters Laboratories or other approved testing organization and shall be so labeled unless otherwise permitted by the Authority Having Jurisdiction (Inspector).

B. All materials to be new, free from defects and not less than quality herein specified. Materials shall be designated to insure satisfactory operation and operational life in the environmental conditions which will prevail where they are being installed.

C. Each type of materials furnished shall be of the same make, be standard products of manufacturers regularly engaged in production of such materials and be the manufacturer's latest standard design.

D. All materials, equipment and systems furnished that include provisions for storing, displaying, reporting, interfacing, inputting, or functioning using date specific information shall perform properly in all respects regardless of the century. Any interface to other new or existing materials, equipment or systems shall function properly and shall be century compliant, both in regards to information sent and received.

2.2 SUBSTITUTION OF MATERIALS

A. Comply with Division 01.

2.3 NAMEPLATES

A. Provide nameplates per Section 260553 - Identification for Electrical Systems.

PART 3 - EXECUTION

3.1 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft. Handle all equipment carefully to prevent damage, breakage, denting, and scoring of finishes. Do not install damaged equipment.

B. Store products subject to damage by the elements above ground, undercover in a weather tight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instruction.

3.2 CUTTING BUILDING CONSTRUCTION

A. Obtain permission from the Architect and coordinate with other trades prior to cutting. Locate cuttings so they will not weaken structural components. Cut carefully and only the minimum amount necessary. Cut concrete with diamond core drills or concrete saws except where space limitations prevent the use of such tools.

B. All construction materials damaged or cut into during the installation of this work must be repaired or replaced with materials of like kind and quality as original materials by skilled labor experienced in that particular building trade.

3.3 PENETRATION OF BUILDING ELEMENTS

A. General:

1. Penetrations of building elements by electrical systems shall not compromise the performance and integrity of the building element (structural, fire, smoke, waterproof, etc.)

B. Fire and smoke rated elements:

1. Electrical penetrations of fire and smoke rated floor and wall assemblies shall maintain fire-resistance or smoke barrier rating of the assembly. Firestopping materials and installation requirements are specified in Division 7 section "Firestopping".

3.4 PAINTING

A. Items furnished under this Division that are scratched or marred in shipment or installation shall be refinished with touchup paint selected to match installed equipment finish.

3.5 EQUIPMENT CONNECTION

A. For equipment furnished under this or other Divisions of the specifications, or by owner, provide all electrical connections necessary to serve such equipment and provide required control connections to all equipment so that the equipment is fully operational upon completion of the project. Provide disconnect switch as required by code whenever an equipment connection is shown on the drawings.

B. Investigate existing equipment to be relocated and provide new connections as required.

C. Obtain rough-in requirements for equipment furnished under other divisions of this specification prior to roughing-in. Review shop drawings and submittals of other Divisions to determine requirements.

3.6 CLEAN UP

A. Contractor shall continually remove debris, cuttings, crates, cartons, etc., created by his work. Such clean up shall be done daily and at sufficient frequency to eliminate hazard to the public, other workmen, the building or the Owner's employees. Before acceptance of the installation, Contractor shall carefully clean cabinets, panels, lighting fixtures, wiring devices, cover plates, etc., to remove dirt, cuttings, paint, plaster, mortar, concrete, etc. Blemishes to finished surfaces of apparatus shall be removed and new finish equal to the original applied.

1. Wipe surfaces of electrical equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

3.7 TESTING AND DEMONSTRATION

A. Demonstrate that all electrical equipment operates as specified and in accordance with manufacturer's instructions. Perform tests in the presence of the Architect, Owner or Engineer. Provide all instruments, manufacturer's operating instructions and personnel required to conduct the tests. Repair or replace any electrical equipment that fails to operate as specified and or in accordance with manufacturer's requirements.

DIVISION 28 ELECTRONIC JOB COMPLETION FORM

PROJECT NAME: OSU Weight Room Refresh
PROJECT LOCATION: Oregon State University
DATE: _____

A. Electrical Inspectors Final Acceptance (Copy of certificate attached.)

_____
Name Agency Date

B. Fire Marshal's Final Acceptance of Fire Alarm System (Copy of certificate attached.)

_____
Name Agency Date

C. The following systems have been demonstrated to Owner's representative.

1. Fire Detection and Alarm _____
Owner's Rep Date

D. Record Drawings
Attached Transmitted previously to _____
Date

E. O & M Manuals
Attached Transmitted previously to _____

F. Test Reports
Attached Transmitted previously to _____
Date

G. The work is complete in accordance with contract documents and authorized changes except for

_____
and the architect/engineer's representative is requested to meet with
_____ at _____ on _____
Supervisor of Electrical Work Time Date

_____ _____
Contractors Rep. Signature Date

Division 28 Schedule of Values for OSU Sports Performance Center

Description of Work	Amount
Device Rough-in (boxes and raceways) - Labor and Materials	
Circuit Conductors - Labor and Materials	
Fire Detection and Alarm - Labor and Materials	
Testing, Demonstration (AHJ approvals)	
Training	
Close Out (Record Drawings, O&M, etc.) - Materials & Labor	
TOTAL DIVISION 28	

END OF SECTION 28 05 00

SECTION 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

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. The requirements of Section 280500 – Common Work Results for Electronic Safety and Security apply to this section.

C. All Division 28 Specification Sections in this Specification Manual must be coordinated to and integrated with this Section. Refer to the Specifcation Manual Table of Contents for a Complete listing of Division 28 Specification Sections.

D. SUMMARY

E. Section Includes:

1. UTP cabling.
2. 50/125 micrometer, multimode optical fiber cabling.
3. Coaxial cabling.
4. RS-232 cabling.
5. RS-485 cabling.
6. Low-voltage control cabling.
7. Control-circuit conductors.
8. Fire alarm wire and cable.
9. Identification products.

1.2 DEFINITIONS

A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.

B. BICSI: Building Industry Consulting Service International.

C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel section.

D. EMI: Electromagnetic interference.

E. IDC: Insulation displacement connector.

F. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

G. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

H. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

I. RCDD: Registered Communications Distribution Designer.

J. Solid-Bottom or Non-ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.

K. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

L. UTP: Unshielded twisted pair.

1.3 SUBMITTALS

A. Provide submittal information in accordance with Division 01 and supplementary requirements described in this specification.

B. Remaining paragraphs are defined in Division 01 Section "Submittal Procedures" as "Informational Submittals."

C. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

D. Source quality-control reports.

1.4 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.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.

2. Smoke-Developed Index: 50 or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.

2. Test optical fiber cable on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.

3. Test each pair of UTP cable for open and short circuits.

1.6 PROJECT CONDITIONS

A. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.

1. Indications that wire and cables are wet or moisture damaged include, but are not limited to, discoloration and sagging of factory packing materials.

B. Environmental Limitations: Do not deliver or install UTP, optical fiber, and coaxial cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Superior Essex Inc.
2. Description: 100-ohm, 4-pair UTP, formed into 25-pair binder groups covered with a blue thermoplastic jacket.
3. Comply with ICEA S-90-661 for mechanical properties.
4. Comply with TIA/EIA-568-B.1 for performance specifications.
5. Comply with TIA/EIA-568-B.2, Category 6.
6. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
    a. Communications, General Purpose: Type CM or CMG.
    b. Communications, Plenum Rated: Type CMP], complying with NFPA 262.
    c. Communications, Riser Rated: Type CMR, complying with UL 1666.
    d. Communications, Limited Purpose: Type CMX .
    e. Multipurpose: Type MP or MPG.
    f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
    g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.2 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ortronics

B. Type of connecting hardware depends on the equipment to which cable is connected. Retain first paragraph below if UTP cable terminations are not specified with connected equipment. Specifying connecting hardware here permits testing of cables before they are connected to the equipment.

C. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.

D. Connecting Blocks 110-style for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

2.3 OPTICAL FIBER CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Corning Incorporated; Corning Cable Systems.
2. Description: Multimode, 50/125-micrometer, fiber count per plans, tight buffer, optical fiber cable.
3. Comply with ICEA S-83-596 for mechanical properties.
4. Comply with TIA/EIA-568-B.3 for performance specifications.
5. Comply with[TIA/EIA-492AAAA-B for detailed specifications.
6. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
    a. General Purpose, Nonconductive: Type OFN or OFNG.
    b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
    c. Riser Rated, Nonconductive: Type OFNR complying with UL 1666.
    d. General Purpose, Conductive: Type OFC or OFCG.
    e. Plenum Rated, Conductive: Type OFCP complying with NFPA 262.
    f. Riser Rated, Conductive: Type OFCR, complying with UL 1666.
7. Conductive cable shall be steel armored type.
8. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
9. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

B. Jacket:

1. Jacket Color: Aqua.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.4 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ortronics

B. Cable Connecting Hardware: Meet the Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.

1. Quick-connect, simplex and duplex, Type SC connectors. Insertion loss not more than 0.75 dB.
2. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.5 COAXIAL CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.
2. Belden CDT Inc.; Electronics Division.
3. Coleman Cable, Inc.
4. CommScope, Inc.
5. Draka Cableteq USA.

B. General Coaxial Cable Requirements: CCTV type, recommended by cable manufacturer specifically for analog video transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a maximum loss of 6 dB/100ft at 700MHz.

C. RG-6/U: NFPA 70, Type CM.

1. No. 18 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
2. Single shielded with 95% bare copper braid.
3. Jacketed with black PVC or PE.
4. Suitable for indoor installations.

D. RG6/U (Plenum Rated): NFPA 70, Type CMP.

1. No. 18 AWG, solid, copper-covered steel conductor; foam fluorinated ethylene propylene insulation.
2. Single Shielded with 95% bare copper braid.
3. Copolymer jacket.

2.6 COAXIAL CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha
2. Belden
3. Coleman Cable
4. General Cable

B. Coaxial-Cable Connectors: Type BNC, 75 ohms.

2.7 RS-232 CABLE

A. Standard Cable: NFPA 70, Type CM.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.

2. Polypropylene insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. PVC jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Plastic insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. Plastic jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.8 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CM[or CMG].

1. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.9 LOW-VOLTAGE CONTROL CABLE

A. Paired Lock Cable: NFPA 70, Type CMG.

1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.

1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

C. Paired Lock Cable: NFPA 70, Type CMG.

1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

D. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.

1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Plastic jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.10 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83.

B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83.

C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83.

2.11 FIRE ALARM WIRE AND CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Comtran Corp.
2. Draka Cableteq USA.
3. Genesis Cable Products; Honeywell International, Inc.
4. Rockbestos-Suprenant Cable Corporation.
5. West Penn Wire/CDT; a division of Cable Design Technologies.

B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

C. Signaling Line Circuits: Twisted, shielded pair.

D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-Voltage Circuits: No. 16 AWG, minimum.

2. Line-Voltage Circuits: No. 12 AWG, minimum.

2.12 IDENTIFICATION PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation

2. HellermannTyton.

3. Kroy LLC.

4. Panduit Corp.

B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Comply with requirements in Section 260553 Identification for Electrical Systems.

2.13 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.

E. Factory sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.

F. Cable will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHOD

A. Install wiring in metal raceways and wireways. Conceal raceway except in unfinished spaces and as indicated. Minimum conduit size shall be 3/4 inch (21 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.

B. Install wiring in raceways except in accessible indoor ceiling spaces and in interior hollow gypsum board partitions where cable may be used. Conceal raceways and wiring except in unfinished spaces and as indicated. Minimum conduit size shall be 3/4 inch (21 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.

C. Install cable, concealed in accessible ceilings, walls, and floors when possible.

D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Boxes and enclosures containing security system components or cabling, and which are easily accessible to employees or to the public shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secued with tamperproof screws.

F. Install end of the line resistors at the field device location and not at the controller or panel location, unless otherwise noted.

3.2 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
9. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation: Install using techniques, practices, and methods that are consistent with Category 6 rating of components and that ensure Category 6 performance of completed and linked signal paths, end to end.

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.
2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.

E. Outdoor Coaxial Cable Installation:

1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).

F. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1525 mm) apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

G. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 72 inches (1830 mm) long shall be neatly coiled not less than [12 inches (300 mm)] in diameter below each feed point.

H. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.

   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).

   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).

6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.3 FIRE ALARM WIRING INSTALLATION

A. Comply with NECA 1 and NFPA 72.

B. Wiring Method: Install wiring in metal raceway according to Section 260533 Raceway and Boxes for Electrical Systems.

1. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.

C. 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.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

E. 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.

3.4 POWER AND CONTROL-CIRCUIT CONDUCTORS

A. 120-V Power Wiring: Install according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.

B. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits, No. 14 AWG.

2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.

3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.5 CONNECTIONS

A. Comply with requirements in Section 281300 Access Control for connecting, terminating, and identifying wires and cables.

B. Comply with requirements in Section 282300 Video Surveillance for connecting, terminating, and identifying wires and cables.

C. Comply with requirements in Division 28 Section "Digital Addressable Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

3.6 FIRESTOPPING

A. Comply with requirements in Division 07 Penetration Firestopping.

B. Comply with TIA/EIA-569-A, Firestopping Annex A.

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.7 GROUNDING

A. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

3.8 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 Identification for Electrical Systems.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Visually inspect UTP and optical fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

4. Optical Fiber Cable Tests:

a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

b. Link End-to-End Attenuation Tests:

1) Multimode Link Measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
2) Attenuation test results for links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

C. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

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 28 05 13

SECTION 28 31 11 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

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. All Division 28 Specification Sections must be coordinated with and integrated into this Section.

C. Section 08 71 00 – Door Hardware

D. Section 21 10 00 – Water Based Fire Suppression Systems

E. Division 23 – Heating Ventilation and Air Conditioning (HVAC)

F. Section 25 30 00 – Integrated Automation Instrumentation and Terminal Devices

G. Division 26 Electrical

1.2 DEFINITIONS

A. LED: Light-emitting diode.

B. NICET: National Institute for Certification in Engineering Technologies.

1.3 SYSTEM DESCRIPTION

A. Noncoded addressable system, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways 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 and the unit will be fully operational after the seismic event."

B. System shall comply with the latest adopted edition of the following codes and standards:

1. Oregon Structural Specialty Code (OSSC)
2. Oregon Fire Code (OFC)
3. National Fire Alarm and Signaling Code – NFPA 72
4. Oregon Electrical Specialty Code (OESC)
5. Factory Mutual (FM) Global Data Sheet 5-40 – Fire Alarm Systems

1.5 CONTRACTOR DESIGN

A. The contract drawings indicate the general nature of the fire alarm system, but do not necessarily show all components or system aspects required by this specification. The drawings are intended to aid the contractor in providing the complete fire alarm system.

B. Notification device performance: The locations of fire alarm notification devices shown on the drawings indicate the rooms and spaces to be covered by the indicated types of devices, but not necessarily the total quantity of devices required in each room or space to meet the applicable codes, as device performance varies among manufacturers. Contractor shall provide design calculations based on vendor device performance characteristics for each space and notification method indicating compliance with applicable codes and criteria.

C. Raceways, routing and wiring are not shown on the drawings and it shall be the responsibility of the contractor to design raceway routing and wiring and to show the same on shop drawings.

D. Shop drawings shall be stamped by the vendor's professional engineer registered in the State of Oregon who shall serve as the engineer of record for the fire alarm system.

1.6 SUBMITTALS

A. Provide submittal information in accordance with Division 01 and supplementary requirements described in this specification.

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Submittals will be reviewed by the design team AND the OSU Facilities Alarms Shop.
3. Shop Drawings shall be prepared by persons with the following qualifications:
    a. Trained and certified by manufacturer in fire-alarm system design.
    b. NICET-certified fire-alarm technician, Level IV minimum.

B. Product Data: For each type of product indicated.

C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
3. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
4. Drawings showing the location of each addressable device and each notification device with details as needed to comply with listing conditions of the device.
5. Floor plans showing size and route of cable and raceways.

D. Design Calculations: To comply with codes, performance requirements and design criteria, include analysis:

1. Battery sizing calculations
2. Voltage drop calculations
3. Visible and audible notification device performance demonstrating compliance with NFPA 72 and local building code.

E. Input/Output Matrix

1. Submit matrix showing for each system input the appropriate system response including control unit annunciation, notification appliance activation, fire safety controls, and supplementary actions.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Seismic Qualification Certificates: For fire-alarm control unit, 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.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
    a. Frequency of testing of installed components.
    b. Frequency of inspection of installed components.
    c. Requirements and recommendations related to results of maintenance.
    d. Manufacturer's user training manuals.
5. Provide permanently mounted updated zone map adjacent to each FACP and FAA (Fire Alarm Annunciator). Maps sized to be clearly visible without magnification.

6. Manufacturer's required maintenance related to system warranty requirements.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.9 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 for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
3. Smoke Detectors, Heat Detectors: Quantity equal to 6 percent of amount of each type installed, but no fewer than 1 unit of each type.
4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.
5. Manual Pull Stations: Quantity equal to 2% of amount installed, but no fewer than one.
6. Keys and Tools: One extra set for access to locked and tamperproofed components.
7. Interior Audible and Visual Notification Appliances: Quantity equal to 4% of amount of each type installed, but no fewer than One of each type installed.
8. Exterior Audible and Visual Notification Appliances: Quantity equal to 2% of amount of each type installed, but no fewer than One of each type installed.
9. Fuses: Two of each type installed in the system.
10. Intelligent Modules: Quantity equal to 4% of each type installed, but no fewer than one of each type installed.

1.10 QUALITY ASSURANCE

A. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.

B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of the existing EST Quickstart QS4 system.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL or UL-listed alarm company.

1.11 SERVICE INTERRUPTION

A. Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions

1. Notify Architect no fewer than fourteen days in advance of proposed interruption of fire-alarm service.

2. Do not proceed with interruption of fire-alarm service without Architect's written permission.

3. Provide “fire watch” or similar temporary guard service to affirm the same role as the fire alarm system in protecting the facility’s occupants and the owner’s property. Obtain approval from the authority having jurisdiction for the proposed method.

1.12 SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following to extent/expand the existing system:

1. GE/Edwards EST

2.2 SYSTEM OPERATIONAL DESCRIPTION

A. Non-coded, UL-certified addressable system, with multiplexed signal transmission and horn/strobe evacuation.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fire-alarm signal initiation shall be by one or more of the following components:

1. Manual stations.

2. Smoke detectors.

3. Duct smoke detectors.

4. Automatic sprinkler system water flow.

D. Fire-alarm signal shall initiate the actions identified and as required by code. For each required action refer to appropriate discipline drawings (for example architectural for door locks, mechanical for fans and dampers, etc) and determine the quantity, rating, and location of interface modules required to initiate the action. The actions are:

1. Identify alarm at fire-alarm control unit and remote annunciators.

2. Transmit an alarm signal to the remote alarm receiving station.
3. Activate alarm notification appliances in accordance with facility requirements.
4. Door Controls:
    a. Unlock electric door locks in designated egress paths.
    b. Release fire and smoke doors held open by magnetic door holders.
    c. Provide alarm contact closure for security system interface
5. HVAC System Interface
    a. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
    b. Return Air Fan Shut Down: Shutdown systems conveying 2000 CFM or more via signal from associated smoke detector.
    c. Smoke Dampers
        1) Close smoke dampers in accordance with smoke control requirements of the International Building Code.
        2) Closure shall be initiated by a smoke detector(s) in the duct, or as otherwise permitted by code.
6. Record events in the system memory.

E. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
2. Low-air-pressure switch of a dry-pipe sprinkler system.

F. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.
9. Addressable device missing, non-functional, improper, or unconfigured at programmed address. Multiple devices at same address.
10. Low-air-pressure switch operation on a dry-pipe sprinkler system.

G. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer.

2.3 FIRE-ALARM CONTROL UNIT (FACU)

A. General Requirements for expanding and interfacing with existing Fire-Alarm Control Unit:

1. Integrate all system components in accordance with the System Operational Description.
2. Existing panel is field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
    a. Provide modular labeling of new/revised components.
3. Addressable initiation devices that communicate device identity and status.
    a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
4. Cabinetry:
    a. NEMA 1 with transparent, keyed, hinged outer door
    b. Internal buttons for alarm acknowledge, testing, alarm silence,

B. User Interface: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

C. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

D. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

E. Testing; The system shall meet NFPA 72 testing and maintenance requirements without the need to manually remove and test each smoke detector.

F. Audible Notification Circuits:

1. Notification shall sound in a pattern acceptable to the Fire Marshall and Owner.

G. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters powered by 24-V dc source.

1. Provide surge protection on incoming power
2. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

3. Provide visual and remote indication when the FACP loses power and is on battery backup. Remote indication/alarm shall be on 90 second delay to allow for generator testing without creating nuisance alarms.

H. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed, valve-regulated, recombinant lead acid. Sized to sustain and operate system as required by local codes, but no less than for 24 hours in standby mode followed by 15 minutes in alarm mode.

2. Battery charger shall completely recharge batteries within 48 hours.

2.4 CIRCUITS

A. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.

1. Signaling Line Circuits: Style 4

2. Install no more addressable devices on each signaling line circuit than 70% of the signaling line circuit capacity. Circuits shall not be shared between floors or smoke control zones.

3. Power supplies shall have 30% spare capacity.

4. Provide isolation modules on Signaling Line Circuits (SLC) serving multiple floors or more than 50 devices on a single floor.

B. Wire

1. Non-Power-Limited Circuits: Conductors shall be 600-V rated, 75 deg. C, color-coded insulation.

a. Low-Voltage Circuits: No. 16 AWG, minimum, stranded copper (maximum of seven strands).

b. Line-Voltage Circuits: No. 12 AWG, minimum, solid or stranded copper.

2. Power-Limited Circuits: NFPA 70, Types FPL, FPLR, or FPLP, as recommended by manufacturer.

C. Raceways, Outlets, and Junction Boxes

1. All fire alarm wiring shall be in conduit, ¾” minimum with minimum 4” square junction boxes for junctions and termination.

2. Shall conform to specification sections "Raceways" and "Outlet and Junction Boxes".

3. Provide 5" square by 2-2/7" deep outlet boxes with plaster ring for all flush mounted notification appliances.

2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.

2. Detectors shall be two-wire type for power limited circuits.

3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
5. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
6. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
    a. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. Detectors address shall be visible without having to remove it from the duct.
3. Shall operate at 300 to 400 feet per minute
4. Shall initiate a supervisory alarm when activated.
5. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).
6. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
7. Each sensor shall have multiple levels of detection sensitivity.

8. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.

9. Provide remote indicator lights for duct smoke detectors.

2.6 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Rated Light Output:

a. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.

3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.

4. Flashing shall be in a temporal pattern, synchronized with other units.

5. Strobe Leads: Factory connected to screw terminals.

6. Mounting Faceplate: Factory finished, red.

2.7 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: Flush cabinet, NEMA 250, Type 1.

2. Location: Annunciators mounted outdoors shall be rated for the environment.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.8 ADDRESSABLE INTERFACE DEVICES

A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating or supervisory/reporting devices,for wired applications. .

B. In NEMA 1 enclosure with exterior label. Internal label with I/O point(s) identification.

C. Integral Relay: Capable of providing a direct signal with appropriate contact ratings to system interface, or receiving signal from system interface, including but not limited to:

1. Fan shutdown motor controller
2. Door holders/lock release.
3. Security system
4. Pre-action sprinkler system

D. Smoke Dampers:

1. Smoke damper interface modules and relays shall be enclosed in a NEMA 1 cabinet with hinged door and handle latch. Door interior shall contain circuit diagram for each module/relay and its associated dampers. Provide one cabinet per each smoke compartment and at least one per floor.
2. Relays contacts shall be suited to the load. Relay contacts shall be loaded to no more than 70% of their rating.

2.9 OVERVOLTAGE AND SURGE PROTECTION

A. All equipment connected to alternating current circuits shall be protected from surges in accordance with IEEE C62.41.1/IEEE C62.41.2 B3 combination waveform and NFPA 70. Fuses shall not be used for surge protection. The surge protector shall be rated for a maximum let thru voltage of 350 Volts ac (line-to-neutral) and 350 Volt ac (neutral-to-ground).

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

1. Mount signaling and notification devices within the more stringent of the restrictions imposed by NFPA 72 and the restrictions imposed by device manufacturer.

B. Wiring

1. Install all wiring in raceways dedicated to the fire alarm system
2. Wiring in panels, cabinets, and other enclosures shall be neatly bundled and channeled. Provide channel routing to all I/O and neatly fan wiring to terminus.
3. Ground per code.

C. Equipment Mounting: Install wall-mounted equipment, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

1. Comply with requirements for seismic-restraint devices specified in Division 26 Section "Seismic Controls for Electrical Systems."

D. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.
2. Connect new equipment to existing monitoring equipment at the supervising station.

3. Expand, modify, and supplement existing control and monitoring equipment as necessary to extend existing control and monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

E. Smoke- Detector Spacing:

1. Comply with NFPA 72.

2. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.

3. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

G. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

H. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

I. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn, unless it is integral with audible alarm indicating device. Install wall mounted devices such that the bottom of the lens is not less than 80 inches above the finished floor. Ceiling mount devices allowed where shown and shall be approved for ceiling application. More than two visible notification devices in the same room or adjacent space within the field of view shall flash in synchronization. Synchronization of devices not in the same field of view is allowed. In corridors where there are more than two devices in any field of view, they shall be spaced a minimum of 55' apart or they shall flash in synchronization.

J. Device Location-Indicating Lights: Locate in public space near the device they monitor.

K. Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.

L. Fan Shut down relays: Install within 5 feet of the motor controller.

M. Smoke Damper Relay cabinets: Wall mount in electrical room on same floor as smoke dampers.

3.2 CONNECTIONS

A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Smoke dampers in air ducts of designated air-conditioning duct systems.

2. Supervisory connections at valve supervisory switches, including exterior Post Indicator Valve.

3. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Provide labeling of all devices and appliances with their respective system address. Label to be produced from an electronic labeling system visible from the floor without magnification. Hand written labels are not acceptable.

C. Provide labeling of all conductors and cables at termination points in panels, cabinets, and junction boxes. Label to be produced from an electronic labeling system. Hand written labels are not acceptable.

3.4 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

B. 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.

C. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.

b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

3. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

E. Fire-alarm system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system. Training to be provided for both Operator and Technician levels and training hours distributed accordingly. Operator training to include all control panel functions and creation of reports. Technician training to include hardware repair and maintenance by University Personnel of all building panels, devices, and appliances, diagnostic procedures, system expansion and maintenance techniques.

END OF SECTION 28 31 11