To: Prospective Bidders

From: Wold Architects and Engineers

Date: April 30, 2019

Comm. No: 195015

Subject: Addendum No. 1 for Bidding Documents for the Alice Terry Elementary Improvements Englewood, Colorado

***NOTE BID DATE CHANGE***

BIDS DUE MAY 7, 2019 AT 2:00 P.M.

This addendum forms a part of the Contract Documents dated April 8, 2019. Acknowledge receipt of this Addendum on the space provided on the Bid Form. Failure to do so may result in disqualification of Bid.

THE ENTIRETY OF THE PROJECT MANUAL IS ATTACHED, HOWEVER, ONLY THE SECTIONS NOTED BELOW HAVE BEEN REVISED.

This Addendum consists of two (2) typed sheet and attachments:
Specification Sections: 00 01 01, 0 01 10, 00 11 13, 04 20 00

PROJECT MANUAL
1. SPECIFICATION SECTION 00 01 01 PROJECT IDENTIFICATION PAGE
   A. Reissued this addendum.
2. SPECIFICATION SECTION 00 01 10 TABLE OF CONTENTS
   A. Reissued this addendum.
3. SPECIFICATION SECTION 00 11 13 ADVERTISEMENT FOR BID
   A. Reissued this addendum.
4. SPECIFICATION SECTION 04 20 00 NON-BEARING UNIT MASONRY
   A. Issued this addendum.
PRE-BID QUESTIONS / ANSWERS

1. **Question:** Has there been asbestos testing done on areas that are to be distributed within the restrooms?
   **Answer:** Testing for ACMs in the toilet room area will still be performed by the District. No information is currently available. District will handle removals if needed.

2. **Question:** Who is the approved FA vendor for ATES?
   **Answer:** The approved FA vendor is Impact Fire (formerly Metro State Fire).

3. **Question:** Is there a roof warranty in effect?
   **Answer:** Yes, it is a 20-year warranty and is a Tremco roof.

4. **Question:** Who is responsible for soil compaction testing and concrete testing?
   **Answer:** The District will secure a testing agent if required.

END OF ADDENDUM #1
Project Manual

ALICE TERRY ELEMENTARY IMPROVEMENTS

SHERIDAN SCHOOL DISTRICT #2
ENGLEWOOD, COLORADO
APRIL 8, 2019
PROJECT M A N U A L

PROJECT IDENTIFICATION

BIDDING REQUIREMENTS

CONDITIONS OF THE CONTRACT

GENERAL REQUIREMENTS

AND SPECIFICATIONS FOR:

ALICE TERRY ELEMENTARY IMPROVEMENTS

4485 SOUTH IRVING STREET
ENGLEWOOD, COLORADO 80110

SHERIDAN SCHOOL DISTRICT #2
ENGLEWOOD, COLORADO 80110

Bid Time: 2:00 PM

Bid Date: May 7, 2019

Bid Place: SOAR Academy

4107 South Federal Boulevard

Englewood, Colorado 80110
SECTION 00 01 03

TITLE PAGE

PROJECT TITLE AND LOCATION: ALICE TERRY ELEMENTARY IMPROVEMENTS
4485 SOUTH IRVING STREET
ENGLEWOOD, COLORADO 80110

OWNER: SHERIDAN SCHOOL DISTRICT #2

ARCHITECTS: Wold Architects and Engineers
1553 Platte Street, Suite 201
Denver, Colorado 80202
Tel. (303) 928-8800

MECHANICAL ENGINEER: BranchPattern
Johns Manville Plaza
717 17th Street, Suite 1500
Denver, Colorado 80202
Tel. (303) 382-1920

ELECTRICAL ENGINEER: BranchPattern
Johns Manville Plaza
717 17th Street, Suite 1500
Denver, Colorado 80202
Tel. (303) 382-1920

DATE: April 8, 2019
SECTION 00 01 05

PROFESSIONAL CERTIFICATIONS

ALICE TERRY ELEMENTARY IMPROVEMENTS

SHERIDAN SCHOOL DISTRICT #2

Wold Architects and Engineers

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision, and that I am a duly Licensed Architect under the laws of the State of Colorado.

JOB GUTIERREZ

April 8, 2019

402410

Registration

BranchPattern

Mechanical Engineer

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the State of Colorado.

ROBERT WEBBER

April 8, 2019

31914

Registration

BranchPattern

Electrical Engineer

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the State of Colorado.

STEVEN ERNST

April 8, 2019

29467

Registration

No. 195015

00 01 05-1

Professional Certifications
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SECTION 00 11 13

ADVERTISEMENT FOR BID

ALICE TERRY ELEMENTARY IMPROVEMENTS
4485 SOUTH IRVING STREET
ENGLEWOOD, COLORADO 80110

Sheridan School District #2 will receive single prime sealed bids for Alice Terry Elementary Improvements until 2:00 PM, local time, on May 7, 2019, SOAR Academy, 4107 South Federal Boulevard, Englewood, Colorado 80110, at which time and place, all bids will be publicly opened and read aloud.

This project includes: Interior renovations and site improvements.

The contract documents will be available for review and download at the following district website: www.ssd2.org

A pre-bid meeting is scheduled for April 23, 2019 at 9:00 AM at Alice Terry Elementary, 4485 South Irving Street, Englewood, Colorado 80110. Attendance is highly recommended.

Make proposals on the bid forms supplied in the Project Manual. No oral, telegraphic, or telephonic proposals or modifications will be considered. Submit with each bid, a certified check or acceptable bidder’s bond, payable to Sheridan School District #2, in an amount equal to five percent (5%) of the total bid. The successful bidder will be required to furnish a satisfactory Labor and Material Payment Bond and a Performance Bond.

Bids may not be withdrawn within thirty (30) days after the scheduled time of opening bids, without the consent of the Owner. The Owner reserves the right to accept any bid or to reject any or all bids, or parts of such bids, and waive informalities or irregularities in bidding.

The Owner requires substantial completion of the project on or before August 9, 2019.

Board of Education

SHERIDAN SCHOOL DISTRICT #2
SECTION 00 21 13

INSTRUCTIONS TO BIDDERS

The Instructions to Bidders, AIA Document A701, 1997 is attached after this section.
END OF SECTION 00 21 13
Instructions to Bidders

for the following PROJECT:
(Name and location or address):
Alice Terry Elementary Improvements
4485 South Irving Street
Englewood, Colorado 80110

THE OWNER:
(Name and address):
Sheridan School District #2
4150 South Hazel Court
Englewood, Colorado 80110

THE ARCHITECT:
(Name and address):
Wold Architects and Engineers
1553 Platte Street
Suite 201
Denver, Colorado 80202

TABLE OF ARTICLES
1  DEFINITIONS
2  BIDDER'S REPRESENTATIONS
3  BIDDING DOCUMENTS
4  BIDDING PROCEDURES
5  CONSIDERATION OF BIDS
6  POST-BID INFORMATION
7  PERFORMANCE BOND AND PAYMENT BOND
8  FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

ADDITIONS AND DELETIONS:
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An Additions and Deletions Report that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.
ARTICLE 1 DEFINITIONS
§ 1.1 Bidding Documents include the Bidding Requirements and the proposed Contract Documents. The Bidding Requirements consist of the Advertisement or Invitation to Bid, Instructions to Bidders, Supplementary Instructions to Bidders, the bid form, and other sample bidding and contract forms. The proposed Contract Documents consist of the form of Agreement between the Owner and Contractor, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications and all Addenda issued prior to execution of the Contract.

§ 1.2 Definitions set forth in the General Conditions of the Contract for Construction, AIA Document A201, or in other Contract Documents are applicable to the Bidding Documents.

§ 1.3 Addenda are written or graphic instruments issued by the Architect prior to the execution of the Contract which modify or interpret the Bidding Documents by additions, deletions, clarifications or corrections.

§ 1.4 A Bid is a complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.

§ 1.5 The Base Bid is the sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be added or from which Work may be deleted for sums stated in Alternate Bids.

§ 1.6 An Alternate Bid (or Alternate) is an amount stated in the Bid to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.

§ 1.7 A Unit Price is an amount stated in the Bid as a price per unit of measurement for materials, equipment or services or a portion of the Work as described in the Bidding Documents.

§ 1.8 A Bidder is a person or entity who submits a Bid and who meets the requirements set forth in the Bidding Documents.

§ 1.9 A Sub-bidder is a person or entity who submits a bid to a Bidder for materials, equipment or labor for a portion of the Work.

ARTICLE 2 BIDDER'S REPRESENTATIONS
§ 2.1 The Bidder by making a Bid represents that:
§ 2.1.1 The Bidder has read and understands the Bidding Documents or Contract Documents, to the extent that such documentation relates to the Work for which the Bid is submitted, and for other portions of the Project, if any, being bid concurrently or presently under construction.

§ 2.1.2 The Bid is made in compliance with the Bidding Documents.

§ 2.1.3 The Bidder has visited the site, become familiar with local conditions under which the Work is to be performed and has correlated the Bidder's personal observations with the requirements of the proposed Contract Documents.

§ 2.1.4 The Bid is based upon the materials, equipment and systems required by the Bidding Documents without exception.

ARTICLE 3 BIDDING DOCUMENTS
§ 3.1 COPIES
§ 3.1.1 Bidders may obtain complete sets of the Bidding Documents from the issuing office designated in the Advertisement or Invitation to Bid.

§ 3.1.2 Bidding Documents will not be issued directly to Sub-bidders unless specifically offered in the Advertisement or Invitation to Bid, or in supplementary instructions to bidders.
§ 3.1.3 Bidders shall use complete sets of Bidding Documents in preparing Bids; neither the Owner nor Architect assumes responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

§ 3.1.4 The Owner and Architect may make copies of the Bidding Documents available on the above terms for the purpose of obtaining Bids on the Work. No license or grant of use is conferred by issuance of copies of the Bidding Documents.

§ 3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS
§ 3.2.1 The Bidder shall carefully study and compare the Bidding Documents with each other, and with other work being bid concurrently or presently under construction to the extent that it relates to the Work for which the Bid is submitted, shall examine the site and local conditions, and shall at once report to the Architect errors, inconsistencies or ambiguities discovered.

§ 3.2.2 Bidders and Sub-bidders requiring clarification or interpretation of the Bidding Documents shall make a written request which shall reach the Architect at least seven days prior to the date for receipt of Bids.

§ 3.2.3 Interpretations, corrections and changes of the Bidding Documents will be made by Addendum. Interpretations, corrections and changes of the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely upon them.

§ 3.3 SUBSTITUTIONS
§ 3.3.1 The materials, products and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution.

§ 3.3.2 No substitution will be considered prior to receipt of Bids unless written request for approval has been received by the Architect at least ten days prior to the date for receipt of Bids. Such requests shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitution including drawings, performance and test data, and other information necessary for an evaluation. A statement setting forth changes in other materials, equipment or other portions of the Work, including changes in the work of other contracts that incorporation of the proposed substitution would require, shall be included. The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

§ 3.3.3 If the Architect approves a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approvals made in any other manner.

§ 3.3.4 No substitutions will be considered after the Contract award unless specifically provided for in the Contract Documents.

§ 3.3.5 Where the Contractor chooses to use an item approved by request but other than one shown on the details or specified, he shall be responsible for the coordination of any necessary changes in other work, and shall bear the cost of such changes.

§ 3.4 ADDENDA
§ 3.4.1 Addenda will be transmitted to all who are known by the issuing office to have received a complete set of Bidding Documents.

§ 3.4.2 Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.

§ 3.4.3 Addenda will be issued no later than four days prior to the date for receipt of Bids except an Addendum withdrawing the request for Bids or one which includes postponement of the date for receipt of Bids.

§ 3.4.4 Each Bidder shall ascertain prior to submitting a Bid that the Bidder has received all Addenda issued, and the Bidder shall acknowledge their receipt in the Bid. If a bidder only notes the number of the last issued addendum on
the bid form, they are acknowledging they have received all addenda previous to the noted addendum on the bid form.

ARTICLE 4  BIDDING PROCEDURES
§ 4.1 PREPARATION OF BIDS
§ 4.1.1 Bids shall be submitted in duplicate on the forms included with the Bidding Documents.

§ 4.1.2 All blanks on the bid form shall be legibly executed in a non-erasable medium.

§ 4.1.3 Sums shall be expressed in both words and figures. In case of discrepancy, the amount written in words shall govern.

§ 4.1.4 Interlineations, alterations and erasures must be initialed by the signer of the Bid.

§ 4.1.5 All requested Alternates shall be bid. If no change in the Base Bid is required, enter "No Change."

§ 4.1.6 Where two or more Bids for designated portions of the Work have been requested, the Bidder may, without forfeiture of the bid security, state the Bidder's refusal to accept award of less than the combination of Bids stipulated by the Bidder. The Bidder shall make no additional stipulations on the bid form nor qualify the Bid in any other manner.

§ 4.1.7 Each copy of the Bid shall state the legal name of the Bidder and the nature of legal form of the Bidder. The Bidder shall provide evidence of legal authority to perform within the jurisdiction of the Work. Each copy shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further give the state of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current power of attorney attached certifying the agent's authority to bind the Bidder. The bid submitted shall be notarized.

§ 4.2 BID SECURITY
§ 4.2.1 No bid will be considered, unless it is accompanied by a certified check or acceptable Bid Bond payable without condition to the Owner in an amount equal to five percent (5%) of the total bid. The certified check or Bid Bond which must accompany each bid name is required as a guarantee that the bidder will enter into a contract with the Owner for the work described in the proposal and furnish a performance and payment bond and certificates of insurance as specified after notice by the Owner or Architect that contracts have been awarded to him and are ready for execution.

§ 4.2.2 If a surety bond is required, it shall be written on AIA Document A310, Bid Bond, unless otherwise provided in the Bidding Documents, and the attorney-in-fact who executes the bond on behalf of the surety shall affix to the bond a certified and current copy of the power of attorney.

§ 4.2.3 The Owner will have the right to retain the bid security of the three lowest Bidders to whom an award is being considered until either (a) the Contract has been executed and bonds, if required, have been furnished, or (b) the specified time has elapsed so that Bids may be withdrawn or (c) all Bids have been rejected. The Bid Security of other bidders will be returned by the Owner within a reasonable time after the opening of bids.

§ 4.3 SUBMISSION OF BIDS
§ 4.3.1 All copies of the Bid, the bid security, if any, and any other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the party receiving the Bids and shall be identified with the Project name, the Bidder's name and address and, if applicable, the designated portion of the Work for which the Bid is submitted. If the Bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof.

§ 4.3.2 Bids shall be deposited at the designated location prior to the time and date for receipt of Bids. Bids received after the time and date for receipt of Bids will be returned unopened.
§ 4.3.3 The Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids.

§ 4.3.4 Oral, telephonic, telegraphic, facsimile or other electronically transmitted bids will not be considered.

§ 4.4 MODIFICATION OR WITHDRAWAL OF BID
§ 4.4.1 A Bid may not be modified, withdrawn or canceled by the Bidder for a period of thirty (30) days following the time and date designated for the receipt of Bids, and each Bidder so agrees in submitting a Bid.

§ 4.4.2 Prior to the time and date designated for receipt of Bids, a Bid submitted may be modified or withdrawn by notice to the party receiving Bids at the place designated for receipt of Bids. Such notice shall be in writing over the signature of the Bidder. Written confirmation over the signature of the Bidder shall be received, and date- and time-stamped by the receiving party on or before the date and time set for receipt of Bids. A change shall be so worded as not to reveal the amount of the original Bid.

§ 4.4.3 Withdrawn Bids may be resubmitted up to the date and time designated for the receipt of Bids provided that they are fully in conformance with these Instructions to Bidders.

§ 4.4.4 Bid security, if required, shall be in an amount sufficient for the Bid as resubmitted.

ARTICLE 5 CONSIDERATION OF BIDS
§ 5.1 OPENING OF BIDS
At the discretion of the Owner, if stipulated in the Advertisement or Invitation to Bid, the properly identified Bids received on time will be publicly opened and will be read aloud. An abstract of the Bids may be made available to Bidders.

§ 5.2 REJECTION OF BIDS
The Owner shall have the right to reject any or all Bids. A Bid not accompanied by a required bid security or by other data required by the Bidding Documents, or a Bid which is in any way incomplete or irregular is subject to rejection.

§ 5.3 ACCEPTANCE OF BID (AWARD)
§ 5.3.1 It is the intent of the Owner to award a Contract to the lowest qualified Bidder provided the Bid has been submitted in accordance with the requirements of the Bidding Documents and does not exceed the funds available. The Owner shall have the right to waive irregularities and irregularities in a Bid received and to accept the Bid which, in the Owner's judgment, is in the Owner's own best interests.

§ 5.3.2 The Owner shall have the right to accept Alternates in any order or combination, unless otherwise specifically provided in the Bidding Documents, and to determine the low Bidder on the basis of the sum of the Base Bid and Alternates accepted.

ARTICLE 6 POST-BID INFORMATION
§ 6.1 CONTRACTOR'S QUALIFICATION STATEMENT
Bidders to whom award of a Contract is under consideration shall submit to the Architect, upon request, a properly executed AIA Document A305, Contractor's Qualification Statement, unless such a Statement has been previously required and submitted as a prerequisite to the issuance of Bidding Documents.

§ 6.2 OWNER'S FINANCIAL CAPABILITY
The Owner shall, at the request of the Bidder to whom award of a Contract is under consideration and no later than seven days prior to the expiration of the time for withdrawal of Bids, furnish to the Bidder reasonable evidence that financial arrangements have been made to fulfill the Owner's obligations under the Contract. Unless such reasonable evidence is furnished, the Bidder will not be required to execute the Agreement between the Owner and Contractor.

§ 6.3 SUBMITTALS
§ 6.3.1 The Bidder shall, as soon as practicable or as stipulated in the Bidding Documents, after notification of selection for the award of a Contract, furnish to the Owner through the Architect in writing:
.1 a designation of the Work to be performed with the Bidder's own forces;
.2 names of the manufacturers, products, and the suppliers of principal items or systems of materials and
equipment proposed for the Work; and
.3 names of persons or entities (including those who are to furnish materials or equipment fabricated to a
special design) proposed for the principal portions of the Work.

§ 6.3.2 The Bidder will be required to establish to the satisfaction of the Architect and Owner the reliability and
responsibility of the persons or entities proposed to furnish and perform the Work described in the Bidding
Documents.

§ 6.3.3 Prior to the execution of the Contract, the Architect will notify the Bidder in writing if either the Owner or
Architect, after due investigation, has reasonable objection to a person or entity proposed by the Bidder. If the
Owner or Architect has reasonable objection to a proposed person or entity, the Bidder may, at the Bidder's option,
(1) withdraw the Bid or (2) submit an acceptable substitute person or entity with an adjustment in the Base Bid or
Alternate Bid to cover the difference in cost occasioned by such substitution. The Owner may accept the adjusted
bid price or disqualify the Bidder. In the event of either withdrawal or disqualification, bid security will not be
forfeited.

§ 6.3.4 Persons and entities proposed by the Bidder and to whom the Owner and Architect have made no reasonable
objection must be used on the Work for which they were proposed and shall not be changed except with the written
consent of the Owner and Architect.

ARTICLE 7 PERFORMANCE BOND AND PAYMENT BOND
§ 7.1 BOND REQUIREMENTS
§ 7.1.1 Refer to Section 00 72 00 General Conditions of the Contract for Construction for Bond requirements.

(Paragraphs Deleted)

ARTICLE 8 FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR
Unless otherwise required in the Bidding Documents, the Agreement for the Work will be written on AIA
Document A101, Standard Form of Agreement Between Owner and Contractor Where the Basis of Payment Is a
Stipulated Sum.
BID PROPOSAL FOR: ALICE TERRY ELEMENTARY IMPROVEMENTS
4485 SOUTH IRVING STREET
ENGLEWOOD, COLORADO 80110

BID TO: Sheridan School District #2
SOAR Academy
4107 South Federal Boulevard
Englewood, Colorado 80110

BID FROM: ____________________________________________

We have examined the Contract Documents for the proposed Alice Terry Elementary Improvements as prepared by Wold Architects and Engineers, Denver, Colorado, and the conditions affecting the work.

In accordance therewith the undersigned proposes to furnish all labor and materials for Construction as set forth in the Contract Documents, including Addenda Nos. _______ issued thereto.

1. Accompanying this proposal is a Bid Security for all work, required to be furnished by Contract Documents, the same being subject to forfeiture in the event of default by the undersigned.

2. I agree to complete the Project, provided a contract is executed within 30 calendar days, by August 9, 2019.

3. I understand the Owner reserves the right to reject any or all bids, and it is agreed that this bid may not be withdrawn for a period of thirty (30) days from the opening thereof.

A. Base Bid

1. The Bidder agrees to perform all work including General, Mechanical and Electrical Construction for the Base Bid Sum of:

________________________________________________________ Dollars $

B. Alternates

1. The Bidder agrees to add to or deduct from the Base Bid Sum the following amounts to perform the alternate work described in Section 01 23 00, including all associated costs.

   a. Alternate No. 1 Floor Drains

      Add/Deduct ________________ Dollars $

   b. Alternate No. 2 LVT Flooring

      Add/Deduct ________________ Dollars $

   c. Alternate No. 3 Urinal Replacements

      Add/Deduct ________________ Dollars $

No. 195015  00 41 13-1  Bid Form
DATE  
FIRM NAME  
OFFICIAL ADDRESS  

TELEPHONE NUMBER  
FAX NUMBER  

BY  
TITLE  
(Owner or Officer)  

STATE OF  
COUNTY OF  

Sworn to and subscribed to before me this _____ day of _____, 20__.

Notary Public, __________________________ County, State of __________________
My Commission Expires: __________________________

END OF SECTION 00 41 13
SECTION 00 72 00

GENERAL CONDITIONS

END OF SECTION 00 72 00
for the following PROJECT:
(Name and location or address)

Alice Terry Elementary Improvements
4485 South Irving Street
Englewood, Colorado 80110

THE OWNER:
(Name and address)

Sheridan School District #2
4150 South Hazel Court
Englewood, Colorado 80110

THE ARCHITECT:
(Name and address)
Wold Architects and Engineers
1553 Platte Street
Suite 201
Denver, Colorado 80202

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12 UNCOVERING AND CORRECTION OF WORK
13 MISCELLANEOUS PROVISIONS

ADDITIONS AND DELETIONS:
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An Additions and Deletions Report that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.
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ARTICLE 1 GENERAL PROVISIONS
§ 1.1 BASIC DEFINITIONS
§ 1.1.1 THE CONTRACT DOCUMENTS
The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor’s bid or proposal, or portions of Addenda relating to bidding requirements.

§ 1.1.2 THE CONTRACT
The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect’s consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect’s consultants or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect’s duties.

§ 1.1.3 THE WORK
The term “Work” means the construction and services required by the Contract Documents, whether completed or partially completed, and includes 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.

§ 1.1.4 THE PROJECT
The Project is 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 by separate contractors.

§ 1.1.5 THE DRAWINGS
The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules and diagrams.

§ 1.1.6 THE SPECIFICATIONS
The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 INSTRUMENTS OF SERVICE
Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect’s consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 ARCHITECT/INITIAL DECISION MAKER
The Architect/Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2 and certify termination of the Agreement under Section 14.2.2.

§ 1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS
§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.
§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings. In the event of conflicts or discrepancies among the Contract Documents, interpretations will be based on the following priorities:

1. The Agreement
2. Change Orders and Supplemental Instructions.
3. Addenda, with those of later date having precedence over those of earlier date.
4. The Supplementary Conditions.
5. The General Conditions of the Contract for Construction.
6. Drawings and Specifications

In the case of an inconsistency between Drawings and Specifications or within either Document not clarified by addendum, the better quality or great quantity of Work shall be provided in accordance with the Architect’s interpretations.

(Paragraph Deleted)

§ 1.3 CAPITALIZATION
Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 INTERPRETATION
In the interest of brevity the Contract Documents frequently omit modifying words such as “all” and “any” and articles such as “the” and “an,” but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS AND OTHER INSTRUMENTS OF SERVICE
§ 1.5.1 The Architect and the Architect’s consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and will retain all common law, statutory and other reserved rights, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with this Project is not to be construed as publication in derogation of the Architect’s or Architect’s consultants’ reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are authorized to use and reproduce the Instruments of Service provided to them solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers may not use the Instruments of Service on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and the Architect’s consultants.

§ 1.6 TRANSMISSION OF DATA IN DIGITAL FORM
If the parties intend to transmit Instruments of Service or any other information or documentation in digital form, they shall endeavor to establish necessary protocols governing such transmissions, unless otherwise already provided in the Agreement or the Contract Documents.

ARTICLE 2 OWNER
§ 2.1 GENERAL
§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner’s approval or authorization.
Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term “Owner” means the Owner or the Owner’s authorized representative.

(Paragraph Deleted)

§ 2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER
§ 2.2.1 Prior to commencement of the Work, the Contractor may request in writing that the Owner provide reasonable evidence that the Owner has made financial arrangements to fulfill the Owner’s obligations under the Contract. Thereafter, the Contractor may only request such evidence if (1) the Owner fails to make payments under the Contract as the Contract Documents require; (2) a change in the Work materially changes the Contract Sum; or (3) the Contractor identifies in writing a reasonable concern regarding the Owner’s ability to make payment when due. The Owner shall furnish such evidence as a condition precedent to commencement or continuation of the Work or the portion of the Work affected by a material change. After the Owner furnishes the evidence, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.2 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.2.3 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work with the exception of utilities to be field verified by the Contractor. The Contractor shall be responsible to have public and private utilities located within the areas being disturbed to implement the work on site.

§ 2.2.4 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner’s control and relevant to the Contractor’s performance of the Work with reasonable promptness after receiving the Contractor’s written request for such information or services.

§ 2.2.5 Unless otherwise provided in the Contract Documents, the Contractor will be furnished free of charge, such copies of the Contract Documents as are reasonably necessary for execution of the Work. Following the initial issue of Drawings and Project Manuals, additional copies requested by the Contractor will be furnished at the cost of reproduction, postage and handling.

§ 2.3 OWNER’S RIGHT TO STOP THE WORK
If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.4 OWNER’S RIGHT TO CARRY OUT THE WORK
§ 2.4.1 Prior to substantial completion, if the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner’s expenses and compensation for the Architect’s additional services made necessary by such default, neglect or failure. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.
§ 2.4.2 After substantial completion, if the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails to correct such deficiencies within 3 days of receipt of written notice from the Architect or Owner, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such a case, an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner’s expenses and compensation for the Architect’s additional services made necessary by such default, neglect or failure. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

ARTICLE 3 CONTRACTOR
§ 3.1 GENERAL
§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term “Contractor” means the Contractor or the Contractor’s authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect’s administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR
§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.2.3, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor’s review is made in the Contractor’s capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor’s notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall make Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities unless the Contractor recognized such error, inconsistency, omission or difference and knowingly failed to report it to the Architect.
§ 3.3 SUPERVISION AND CONSTRUCTION PROCEDURES
§ 3.3.1 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. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely written notice to the Owner and Architect and shall not proceed with that portion of the Work without further written instructions from the Architect. If the Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by the Contractor, the Owner shall be solely responsible for any loss or damage arising solely from those Owner-required means, methods, techniques, sequences or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor’s employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 LABOR AND MATERIALS
§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work authorized by the Architect in accordance with Sections 3.12.8 or 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive. After the Contract has been executed, the Owner and Architect will consider a formal request for the substitution of products in place of those specified only under the conditions set forth in Section 01 25 00 – Substitutions and Product Options.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor’s employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.5 WARRANTY
The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor’s warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.6 TAXES
The Contractor and all of its Subcontractors shall make application to the State Department of Revenue for certificates of exemption to permit the purchase of building materials for the construction of the Project without payment of sales tax. Prior to the start of construction, the Contractor shall furnish copies of such certificates to the Owner. Such applications and certificates must be on forms provided by the Department of Revenue. Any costs, taxes or fines that are incurred as a result of a failure to comply with the requirements of this Subsection 3.6 shall be paid by the Contractor.
§ 3.7 PERMITS, FEES, NOTICES, AND COMPLIANCE WITH LAWS

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

Owner shall pay for Plan Review/Permit Fees, State Review, Inspection Fees (State Inspections by 3rd Party), Local Jurisdiction Fire Code Review Fees, Colorado Geological Survey Fees, and Electrical Connection Charges.

The Contractor is responsible to pay any remaining plan review fees, the building permit and surcharge fee to the local jurisdiction.

(Paragraph Deleted)

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 CONCEALED OR UNKNOWN CONDITIONS. If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature, that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 21 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor’s cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor in writing, stating the reasons. If either party disputes the Architect’s determination or recommendation, that party may proceed as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 ALLOWANCES

§ 3.8.1 The Contractor shall include in the Contract Sum 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, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;

2 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 Sum but not in the allowances; and
whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 SUPERINTENDENT
§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor. Important communications shall be confirmed in writing.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the name and qualifications of a proposed superintendent. The Architect may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect has reasonable objection to the proposed superintendent or (2) that the Architect requires additional time to review. Failure of the Architect to reply within the 14 day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed. The responsibility of the superintendent is to supervise, schedule, coordinate, and manage field operations. The superintendent is not to be used as a tradesman.

§ 3.10 CONTRACTOR'S CONSTRUCTION SCHEDULES
§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall prepare and submit for the Owner's and Architect's information a Contractor's construction schedule for the Work as required by Section 01 32 00 Construction Scheduling. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work.

§ 3.10.2 The Contractor shall prepare a submittal schedule as required by Section 01 32 00 Construction Scheduling, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, and shall submit the schedule(s) for the Architect's approval. The Architect's approval shall not unreasonably be delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the Architect's time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

§ 3.11 DOCUMENTS AND SAMPLES AT THE SITE
The Contractor shall maintain at the site for the Owner one copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and one copy of Architect reviewed Shop Drawings, Product Data, Samples and similar required submittals. These shall be available to the Architect and shall be delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES
§ 3.12.1 Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

§ 3.12.2 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.
§ 3.12.3 Samples are physical examples that illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. Their purpose is to demonstrate the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action. Shop drawings submitted prior to issuance of the building permit are at the Contractors risk.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve and submit to the Architect Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, 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.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and the Contract Documents. Submittals which are not marked as reviewed for compliance with the Contract Documents and approved by the Contractor may be returned by the Architect without action.

§ 3.12.7 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 reviewed by the Architect.

§ 3.12.8 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’s review of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect in writing of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued 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’s review thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such written notice, the Architect’s review of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor’s responsibilities for construction means, methods, techniques, sequences and procedures. The Contractor shall not be required to provide professional services in violation of applicable law. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall cause such services or certifications to be provided by a properly licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional’s written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor all performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review, approve or take other appropriate action on submittals only for the limited purpose of checking for
conformance with information given and the design concept expressed in the Contract Documents. The Contractor shall not be responsible for the adequacy of the performance and design criteria specified in the Contract Documents.

§ 3.12.11 Copies of all Shop Drawings, Product Data, Samples and similar submittals as identified in Paragraph 3.12 shall be preserved in an orderly manner and delivered to the Owner upon Final Completion of the Work.

§ 3.13 USE OF SITE
The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities and the Contract Documents and shall not unreasonably encumber the site with materials or equipment. The Contractor shall accept the site as it exists. The care, custody and control of the project site shall be vested in the Contractor, subject to the rights of the Owner. The Contractor shall take reasonable precautions for the safety of, and shall provide all reasonable protection to prevent damage, injury or loss to, all persons at the site and all property at the site and adjacent thereto. The Contractor acknowledges that the Project site comprises public school facilities that may be occupied during the performance of some portions of this Contract. The Contractor shall notify all public utility companies 48 hours prior to the commencement of any work by it or its Subcontractors in the vicinity of the utilities. No work shall commence until the utilities have been located and staked by the utility company or written consent from the Architect to proceed has been given to the Contractor. If the utility service must be interrupted, the Contractor shall notify the head of the local administrative services (i.e., city manager, mayor or city clerk, as applicable) and the utility users affected by the interruption. Such notice shall consist of publication in a local newspaper and/or announcement on local radio or television stations, whichever is most reasonably calculated to give notice to such utility users.

§ 3.14 CUTTING AND PATCHING
§ 3.14.1 The Contractor shall be responsible for cutting, fitting or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting and patching shall be restored to the condition existing prior to the cutting, fitting and patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor’s consent to cutting or otherwise altering the Work.

§ 3.15 CLEANING UP
§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor’s tools, construction equipment, machinery and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may so do and Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 ACCESS TO WORK
The Contractor shall provide the Owner and Architect access to the Work in preparation and progress wherever located.

§ 3.17 ROYALTIES, PATENTS AND COPYRIGHTS
The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for such defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications or other documents prepared by the Owner or Architect. However, if the Contractor has reason to believe that the required design, process or product is an infringement of a copyright or a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Architect.
§ 3.18 INDEMNIFICATION

§ 3.18.1 To the fullest extent permitted by law the Contractor shall indemnify and hold harmless the Owner, Architect, Architect’s consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys’ fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by 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. 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 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 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 3.18.1 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.

§ 3.19 PROJECT MANAGER

§ 3.19.1 The Contractor shall employ a competent project manager who shall be present and run all construction progress meetings. The project manager shall be responsible for providing accurate and up-to-date construction and submittal schedules at each construction progress meeting.

§ 3.19.2 When requested by the Owner or Architect, the project manager shall:

1. Assist in resolving scope conflicts between sub-contractors in a timely fashion to ensure project progress matches published construction schedule.
2. Have sub-contractors attend construction progress meetings.
3. Manage the resolution of issues that arise during the punchlist/closeout/warranty period when the job superintendent is no longer on site.

§ 3.19.3 The Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the name and qualifications of a proposed project manager. The Architect may require within 14 days to the Contractor is writing stating (1) whether the Owner or the Architect has reasonable objection to the proposed project manager or (2) that the Architect required additional time to review. Failure of the Architect to reply within the 14 days period shall constitute notice of no reasonable objection.

§ 3.19.4 The Contractor shall not employ a proposed project manager to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the project manager without the Owner’s consent, which shall not unreasonably be withheld or delayed.

ARTICLE 4 ARCHITECT

§ 4.1 GENERAL

§ 4.1.1 The Owner shall retain an architect lawfully licensed to practice architecture or an entity lawfully practicing architecture in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number. The term “Architect” means the Architect or the Architect’s authorized representative.

§ 4.1.2 Duties, responsibilities and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified or extended without written consent of the Owner, Contractor and Architect. Consent shall not be unreasonably withheld.

§ 4.1.3 If the employment of the Architect is terminated, the Owner shall employ a successor architect to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.
§ 4.2 ADMINISTRATION OF THE CONTRACT
§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner’s representative during construction until the end of the warranty period which ends one year from the date the Architect issues the final Certificate For Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for, the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor’s rights and responsibilities under the Contract Documents, except as provided in Section 3.3.1.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and report to the Owner (1) known deviations from the Contract Documents and from the most recent construction schedule submitted by the Contractor, and (2) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor’s failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of and will not be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 COMMUNICATIONS FACILITATING CONTRACT ADMINISTRATION
Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate with each other through the Architect about matters arising out of or relating to the Contract. Communications by and with the Architect’s consultants shall be through the Architect. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the Owner.

§ 4.2.5 Based on the Architect’s evaluations of the Contractor’s Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.5.2 and 13.5.3, whether or not such Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review and take one of the following actions: Reviewed; Rejected; Review Comments; Revise and Resubmit upon, the Contractor’s submittals such as Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect’s action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, the Architect will determine review timelines. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, coordinating the work, or for substantiating specifications or instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect’s review of the Contractor’s submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5 and 3.12. The Architect’s review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Architect, of any construction means, methods, techniques, sequences or procedures, The Architect’s approval of a specific item shall not indicate approval of an assembly of which the item is a component.
§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may authorize minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner’s review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate of Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more project representatives to assist in carrying out the Architect’s responsibilities at the site. The duties, responsibilities and limitations of authority of such project representatives shall be as set forth in an exhibit to be incorporated in the Contract Documents.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect’s response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect’s decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect’s response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS
§ 5.1 DEFINITIONS
§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term “Subcontractor” is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term “Subcontractor” does not include a separate contractor or subcontractors of a separate contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term “Sub-subcontractor” is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK
§ 5.2.1 Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. The Architect may reply within 20 days to the Contractor in writing stating (1) whether the Owner or the Architect has reasonable objection to any such proposed person or entity or (2) that the Architect requires additional time for review. Failure of the Owner or Architect to reply within the 20 day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

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§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor’s Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person or entity previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 SUBCONTRACTUAL RELATIONS
By appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor’s Work, which the Contractor, by these Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 CONTINGENT ASSIGNMENT OF SUBCONTRACTS
§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

1. assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor in writing; and

2. assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor’s rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor’s compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon such assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor’s obligations under the subcontract.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS
§ 6.1 OWNER’S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS
§ 6.1.1 The Owner reserves the right to perform construction or operations related to the Project with the Owner’s own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these including those portions related to insurance and waiver of subrogation. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such claim as provided in Article 15.
§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term “Contractor” in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner’s own forces and of each separate contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with other separate contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to the construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, separate contractors and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner’s own forces, the Owner shall be deemed to be subject to the same obligations and to have the same rights that apply to the Contractor under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6 and Articles 10, 11 and 12.

§ 6.2 MUTUAL RESPONSIBILITY
§ 6.2.1 The Contractor shall afford the Owner and separate contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor’s construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor’s Work depends for proper execution or results upon construction or operations by the Owner or a separate contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Architect apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acknowledgment that the Owner’s or separate contractor’s completed or partially completed construction is fit and proper to receive the Contractor’s Work, except as to defects not then reasonably discoverable.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a separate contractor because of the Contractor’s delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a separate contractor’s delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner, separate contractors as provided in Section 10.2.5.

§ 6.2.5 The Owner and each separate contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 OWNER’S RIGHT TO CLEAN UP
If a dispute arises among the Contractor, separate contractors and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

ARTICLE 7  CHANGES IN THE WORK
§ 7.1 GENERAL
§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor and Architect; a Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor; an order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents, and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Construction Change Directive or order for a minor change in the Work.
§ 7.2 CHANGE ORDERS
§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor and Architect stating their agreement upon all of the following:
   .1 The change in the Work;
   .2 The amount of the adjustment, if any, in the Contract Sum; and
   .3 The extent of the adjustment, if any, in the Contract Time.

§ 7.3 CONSTRUCTION CHANGE DIRECTIVES
§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:
   .1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
   .2 Unit prices stated in the Contract Documents or subsequently agreed upon;
   .3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
   .4 As provided in Section 7.3.7.

§ 7.3.4 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed in a proposed Change Order or Construction Change Directive so that application of such unit prices to quantities of Work proposed will cause substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 7.3.5 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor’s agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.6 A Construction Change Directive signed by the Contractor indicates the Contractor’s agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.7 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the method and the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.7 shall be limited to the following:
   .1 Costs of labor, and overhead as provided in Section 7.5.
   .2 Costs of materials, supplies and equipment, including cost of transportation, whether incorporated or consumed;
   .3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
   .4 Costs of premiums for all, permit fees, and sales, use or similar taxes related to the Work; and

(Paragraph Deleted)
§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect’s professional judgment, to be reasonably justified. The Architect’s interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 MINOR CHANGES IN THE WORK
The Architect has authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes will be effected by written order signed by the Architect and shall be binding on the Owner and Contractor.

§ 7.5 CHANGES IN CONTRACT SUM
§ 7.5.1 For any adjustments to the Contract Sum based on other than the unit prices method, the Contractor agrees to charge and accept payment for his overhead, bond, insurance, office project management and supervision estimating time/costs, field management and supervision including the field superintendent, foreman and all other management staff onsite, as-built modification and profit, use or replacement of tools, shop burden, equipment rental (other than specifically required additional hoisting equipment, required excavating equipment or similar equipment necessary solely as a result of the change), engineering costs, cost of safety measures (including those imposed by OSHA), parking charges, general jobsite clean-up, testing, permits (unless a new permit is required) or any other costs not associated with the change and profit at the following percentages of the cost attributable to the change in the Work:

1. Ten percent (10%) for Work (labor, labor insurance and materials by the Contractor not involving subcontractors;
2. Five percent (5%) for Work (labor, labor insurance and materials) by subcontractors;
3. When both additions and credits are involved in any one proposal request, the allowance for overhead, bond, insurance, office project management, estimating time, field supervision, as-built modification and profit shall be figured on the basis of the net increase, if any;
4. For additional Work ordered as described above which will be executed by Subcontractors of the Contractor, it is agreed Subcontractors will be permitted to charge ten percent (10%) for work not involving sub-subcontractors and five percent (5%) for Work by sub-subcontractors. to the net subcontract amount the Contractor may add five percent (5%).

§ 7.5.2 A breakdown of material and an hourly breakdown of labor must be submitted with each request for additional compensation.

ARTICLE 8  TIME
§ 8.1 DEFINITIONS
§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.
§ 8.1.4 The term “day” as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.1.5 The date of Final Completion of the Work is the date that the Architect certifies in the final Certificate for Payment pursuant to Subsection 9.10.1 that the Work is acceptable under the Contract Documents and the Contract is fully performed.

§ 8.2 PROGRESS AND COMPLETION
§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or elsewhere prior to the effective date of insurance required by Article 11 to be furnished by the Contractor and Owner. The date of commencement of the Work shall not be changed by the effective date of such insurance.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.2.4 The Owner shall have the right, without giving the Contractor the right to any extra compensation, at any time when, in the judgment of the Owner, the Work is not proceeding in accordance with the approved progress schedule, to require the Contractor to take such measures or adopt such methods as may be necessary in the Owner’s opinion to obtain and maintain satisfactory progress, but the failure of the Owner to demand that the Contractor adopt such measures shall not relieve the Contractor of its obligation to secure the rate of progress necessary to complete the Work within the time required by the Contract.

§ 8.3 DELAYS AND EXTENSIONS OF TIME
§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by an act or neglect of the Owner or Architect, or of an employee of either, or of a separate contractor employed by the Owner; or by changes ordered in the Work; or by labor disputes, fire, unusual delay in deliveries, unavoidable casualties or other causes beyond the Contractor’s control; or by delay authorized by the Owner pending arbitration or litigation as provided for herein; or by other causes that the Architect determines may justify delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Architect may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 PAYMENTS AND COMPLETION
§ 9.1 CONTRACT SUM
The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.2 SCHEDULE OF VALUES
Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit four copies of the Application for Payment, a schedule of values allocating the entire Contract Sum to the various portions of the Work and prepared in such form and supported by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor’s Applications for Payment.

§ 9.2.1 The schedule of values shall include the following line items with values calculated as follows:

- Operations and maintenance manuals \(0.125\%\) of contract value
- As-built drawings \(0.0625\%\) of contract value
- Training \(0.125\%\) of contract value

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§ 9.2.2 The schedule of values shall be broken down with separate line items for labor and materials corresponding to each specification section.

§ 9.3 APPLICATIONS FOR PAYMENT

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit four copies to the Architect an itemized Application for Payment (AIA Document G702 and G703) prepared in accordance with the schedule of values, if required under Section 9.2., for completed portions of the Work. Such application shall be notarized, and supported by such data substantiating the Contractor’s right to payment as the Owner or Architect may require, such as copies of requisitions from Subcontractors and material suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or material supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.1.3 Payments will be made in the full value of the work performed and materials provided or stored less 5% of such value which shall be retained until the Date of Completion of all Work, unless otherwise agreed by the Owner, and less the aggregate of any previous payments. Upon the certified completion of 50% of the Work, as determined by the Architect and the Owner, and if satisfactory progress is being made in the Work, in the sole opinion of the Owner, then no further retainage shall be made from further monthly payments, subject to any retainages made by the Owner from the final payment. On satisfactory completion and final acceptance, at the discretion of the Owner, payment shall be made in full, including retained percentages, less deductions as determined by the Owner.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner’s title to such materials and equipment or otherwise protect the Owner’s interest, and shall include the costs of applicable insurance, storage and transportation to the site for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants 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 Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor’s knowledge, information and belief, 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 labor, materials and equipment relating to the Work.

§ 9.4 CERTIFICATES FOR PAYMENT

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor’s Application for Payment, either issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect determines is properly due, or notify the Contractor and Owner in writing of the Architect’s reasons for withholding certification in whole or in part as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect’s evaluation of the Work and the data comprising the Application for Payment, that, to the best of the Architect’s knowledge, information and belief, the Work has progressed to the point indicated and that the quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion.
and to specific qualifications expressed by the Architect. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work, (2) reviewed construction means, methods, techniques, sequences or procedures, (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor's right to payment, or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 DECISIONS TO withhold CERTIFICATION
§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

.1 defective Work not remedied;
.2 third party claims filed or reasonable evidence indicating probable filing of such claims unless security acceptable to the Owner is provided by the Contractor;
.3 failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment;
.4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
.5 damage to the Owner or a separate contractor;
.6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
.7 repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When the above reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.3 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or material or equipment suppliers to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Architect will reflect such payment on the next Certificate for Payment.

§ 9.6 PROGRESS PAYMENTS
§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor no later than seven days after receipt of payment from the Owner the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and material and equipment suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay or to see to the payment of money to a Subcontractor, except as may otherwise be required by law.
§ 9.6.5 Contractor payments to material and equipment suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors and suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, shall create any fiduciary liability or tort liability on the part of the Contractor for breach of trust or shall entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.7 FAILURE OF PAYMENT
If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' written notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 SUBSTANTIAL COMPLETION
§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use. If the Work is to be followed by construction by the Owner or by the separate contractors, Substantial Completion shall be defined as the readiness of the Work for the commencement of such construction.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion, shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall fix the time in which the Contractor shall complete all items on the list accompanying the Certificate to sixty (60) calendar days. The Contractor will submit a punchlist completion schedule within ten (10) days of receipt of Certificate of Substantial Completion. Any cost incurred by the Architect or Architect's consultants (after 60 calendar days of substantial completion) to close out the project will be deducted from the Contractor's contract by change order. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion. Warranties on punchlist items will commence on the date of final payment.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety, if
any, the Owner shall make payment of retainage applying to such Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 PARTIAL OCCUPANCY OR USE
§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer as required under Section 11.3.1.5 and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor and Architect 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.

§ 9.9.3 Unless otherwise agreed upon, 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.

§ 9.10 FINAL COMPLETION AND FINAL PAYMENT
§ 9.10.1 Upon receipt of the Contractor’s written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection and, when the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect’s knowledge, information and belief, and on the basis of the Architect’s on-site visits and inspections, the Work has been completed in accordance with terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect’s final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor’s being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner’s property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) 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 30 days’ prior written notice has been given to the Owner, (3) 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, (4) consent of surety, if any, to final payment and (5), 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.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to
certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

§ 9.10.4 The making of final payment shall constitute a waiver of claims by the Owner except those arising from
1. liens, Claims, security interests or encumbrances arising out of the Contract and unsettled;
2. failure of the Work to comply with the requirements of the Contract Documents; or
3. terms of special warranties required by the Contract Documents.
4. Faulty or defective Work first appearing after Substantial Completion.

§ 9.10.5 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.

§ 9.10.6 On the date of final settlement, as advertised, and after the Contractor has submitted a written notice to the Owner that no claims have been filed, final payment shall be made in full. Notwithstanding the foregoing, if any unpaid claim for labor, materials, supplies or equipment is filed with the Owner before payment in full of all sums due the Contractor on the final settlement date, the Owner shall withhold from the Contractor sufficient funds, if available, to ensure the payment of such claim, until the same is paid or withdrawn. Such payment or withdrawal shall be evidenced by filing with the Owner a receipt of payment in full or an order authorizing withdrawal signed by the claimant or its duly authorized agent or assignee. Such funds shall ordinarily not be withheld longer than ninety (90) days following the date fixed for final settlement with the Contractor as set forth in the published notice of final settlement, unless an action at law has been commenced within that time to enforce such unpaid claim and a notice of lis pendens has been filed with the Owner. At the expiration of the ninety (90) day period, the Owner shall release to the Contractor all funds that are not the subject of such action at law. Notwithstanding the provisions in this section, in the event the Colorado statutory procedure as set forth herein is amended during the term of the Contract for Construction, such amended procedure shall be substituted accordingly.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY
§ 10.1 SAFETY PRECAUTIONS AND PROGRAMS
The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 SAFETY OF PERSONS AND PROPERTY
§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury or loss to
1. employees on the Work and other persons who may be affected thereby;
2. the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or the Contractor’s Subcontractors or Sub-subcontractors;
3. other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

§ 10.2.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury or loss.

§ 10.2.3 The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent sites and utilities.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in...
whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3, except damage or loss attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor’s obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor’s organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor’s superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 INJURY OR DAMAGE TO PERSON OR PROPERTY
If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, written notice of such injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.2.9 Notwithstanding any other provision herein, the Contractor shall take all necessary measures to store materials on site for which payment has been made by the Owner so that they shall not deteriorate, be damaged or be stolen. The Contractor shall, to the best of its ability, safeguard such materials against burglary, pilferage, fire, vandalism and mischief. The Contractor shall bear sole responsibility (1) for the care and protection of materials and work installed in the building and materials stored on the site for which payment has been made, and (2) for the restoration of damaged work and replacement of damaged or stolen materials, at no additional cost to the Owner.

§ 10.3 HAZARDOUS MATERIALS
§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and report the condition to the Owner and Architect in writing.

§ 10.3.2 Upon receipt of the Contractor’s written notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of such material or substance or who are to perform the task of removal or safe containment of such material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased in the amount of the Contractor’s reasonable additional costs of shut-down, delay and start-up.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect’s consultants and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys’ fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss or expense is due to the fault or negligence of the party seeking indemnity. Notwithstanding the foregoing, Owner’s indemnification obligation contained in this

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User Notes:
section is only to the extent permitted by law, and it is specifically understood and agreed by Contractor that nothing contained in this section or elsewhere in this Contract shall be interpreted or applied as an express or implied waiver by Owner of its governmental immunity or as an express or implied acceptance by Owner of liabilities arising as a result of actions which lie in tort or could lie in tort in excess of the liabilities allowable under the Colorado Governmental Immunity Act, C.R.S. §§ 24-10-101, et seq.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for materials or substances required by the Contract Documents, except to the extent of the Contractor’s fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall indemnify the Owner for the cost and expense the Owner incurs (1) for remediation of a material or substance the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner’s fault or negligence.

(Paragraph Deleted)

§ 10.4 EMERGENCIES
In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor’s discretion, to prevent threatened damage, injury or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11  INSURANCE AND BONDS
§ 11.1 CONTRACTOR’S LIABILITY INSURANCE
§ 11.1.1 The Contractor shall purchase from and maintain in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located such insurance as will protect the Contractor from claims set forth below which may arise out of or result from the Contractor’s operations and completed operations under the Contract and for which the Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

.1 Claims under workers’ compensation, disability benefit and other similar employee benefit acts that are applicable to the Work to be performed;
.2 Claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor’s employees;
.3 Claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor’s employees;
.4 Claims for damages insured by usual personal injury liability coverage; which are sustained (1) by a person as a result of an offense directly or indirectly related to employment of such person by the Contractor, or (2) by another person;
.5 Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom;
.6 Claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle;
.7 Claims for bodily injury or property damage arising out of completed operations; and
.8 Claims involving contractual liability insurance applicable to the Contractor’s obligations under Section 3.18.
.9 Liability insurance shall include all major divisions of coverage and be on a comprehensive basis including:
  a. Premises Operations (including X, C, and U coverages as applicable).
  b. Independent Contractors’ Protective.
  c. Products and Completed Operations.
  e. Contractual – including specified provision for Contractor’s obligations under Paragraph 3.18.
  f. Owned, non-owned and hired motor vehicles.
  g. Broad Form Property Damage including Completion Operations.
h. Umbrella Excess Liability.

A General Liability or Umbrella Liability Policy on a claims-made basis will not be accepted.

§ 11.1.2 With respect to the insurance required by Subsection 11.1.1, the Contractor shall maintain in effect at all times during the term of this Contract and for all work performed under this contract the following policies of insurance and liability limits:

§ 11.1.2.1 Workers' compensation insurance covering injury to or occupational disease or death of all employees engaged in the Work (including active partners or individual owners) in accordance with the statutory requirements of Colorado, and Employer's Liability insurance with a limit of liability of at least $100,000 each accident; $500,000 policy limit by disease; and $100,000 each employee by disease.

§ 11.1.2.2 Commercial general liability insurance on an occurrence basis covering bodily injury, property damage and personal injury with limits of $2,000,000 each occurrence, $4,000,000 general aggregate per project, $1,000,000 products/completed operations aggregate per project and $1,000,000 personal and advertising injury. A policy which provides such limits of coverage via a primary policy plus an umbrella or following form excess policy will be satisfactory. Coverage must not exclude contractual, professional or products and completed operations liability, nor liability for explosions, collapse or underground risks. The policy must name the Owner as additional insured and shall be endorsed to be primary for the Owner. Coverage shall remain in force for a period of two (2) years after Owner's acceptance of the Work.

§ 11.1.2.3 Automobile liability insurance with a combined single limit of $1,000,000 each accident covering all owned, hired and non-owned vehicles. The policy shall contain a waiver of subrogation in favor of the Owner.

§ 11.1.2.4 The Contractor shall be responsible for all tools, equipment, materials, and the like which are owned, rented or used by the Contractor in performing the Work. If the Contractor obtains a contractor's equipment float or other insurance policy to cover risks to its tools, equipment, materials and the like, the policy shall contain a waiver of subrogation in favor of the Owner.

§ 11.1.3 The insurance of the Contractor described in Subsection 11.1.2 shall be maintained with a carrier satisfactory to the Owner which is duly qualified and licensed to transact business in Colorado. Terms of coverage shall be evidenced by certificates furnished to the Owner. Such certificates must provide that thirty (30) days' written notice shall be given to the Owner prior to cancellation, non-renewal or material change in any policy, and shall be confirmed by written endorsement to each policy. Certificates are to be delivered to the Owner prior to the Contractor's performance of any Work under this Agreement, and any insurance policy may be rejected by Owner at its sole discretion. Acceptance of a certificate with less than the required amounts and coverage shall not be deemed a waiver of the requirements in Subsection 11.1.2.

§ 11.1.4 The Contractor shall require all of its Subcontractors to maintain workers' compensation insurance, commercial general liability insurance and automobile liability insurance with the same limits and conditions as specified in Subsection 11.1.2 for the Contractor.

§ 11.1.5 The Owner may waive or modify any or all of the requirements of this Article 11. Such waiver or modification shall not be effective unless made in writing and executed by the Owner's Board of Education.

§ 11.2 OWNER'S LIABILITY INSURANCE

The Owner shall be responsible for purchasing and maintaining the Owner's usual liability insurance.
§ 11.3 PROPERTY INSURANCE
§ 11.3.1 The Contractor shall purchase and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, property insurance (Special Form) in the amount of the initial Contract Sum as well as subsequent modifications thereto for the entire work at the site on a replacement cost basis. The Contractor shall be responsible for payment of all deductibles resulting from losses under the coverage provided herein. Such insurance will cover damage to work completed, materials installed and awaiting installation, and all materials in transit for the Project. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or agreed upon in writing by all persons and entities who are beneficiaries of such insurance, until all phases are substantially complete or until no person or entity other than the Owner has an insurable interest in the property required by this Paragraph 11.4 to be covered, whichever is earlier. This insurance shall include interests of the Owner, Architects, Engineers, Architect's consultants, Contractor, Subcontractors and Sub-subcontractors in the Work. The form of policy for this coverage shall be completed Value. If the Owner is damaged by the failure of the Contractor to maintain such insurance, then the contractor shall bear all reasonable costs properly attributable thereto.

§ 11.3.1.1 Property insurance shall be on an “all-risk” or equivalent policy form and shall include, without limitation, insurance against the perils of fire (with extended coverage) and physical loss or damage including, without duplication of coverage, theft, vandalism, malicious mischief, collapse, earthquake, flood, windstorm, falsework, testing and startup, temporary buildings and debris removal including demolition occasioned by enforcement of any applicable legal requirements, and shall cover reasonable compensation for Architect’s and Contractor’s services and expenses required as a result of such insured loss.

(Paragraphs Deleted)

§ 11.3.4 This property insurance shall cover portions of the Work stored off the site, and also portions of the Work in transit.

§ 11.3.5 Partial occupancy or use in accordance with Section 9.9 shall not commence until the insurance company or companies providing property insurance have consented to such partial occupancy or use by endorsement or otherwise. The Owner and the Contractor shall take reasonable steps to obtain consent of the insurance company or companies and shall, without mutual written consent, take no action with respect to partial occupancy or use that would cause cancellation, lapse or reduction of insurance.

§ 11.3.2 BOILER AND MACHINERY INSURANCE
The Owner shall purchase and maintain boiler and machinery insurance required by the Contract Documents or by law, which shall specifically cover such insured objects during installation and until final acceptance by the Owner; this insurance shall include interests of the Owner, Contractor, Subcontractors and Sub-subcontractors in the Work, and the Owner and Contractor shall be named insureds. The testing exclusion shall be removed from this policy.

§ 11.3.3 LOSS OF USE INSURANCE
The Owner, at the Owner’s option, may purchase and maintain such insurance as will insure the Owner against loss of use of the Owner’s property due to fire or other hazards, however caused. The Owner waives all rights of action against the Contractor for loss of use of the Owner’s property, including consequential losses due to fire or other hazards however caused.

(Paragraph Deleted)

§ 11.3.5 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, the Owner shall waive all rights in accordance with the terms of Section 11.3.7 for damages caused by fire or other causes of loss covered by this separate property insurance. All separate policies shall provide this waiver of subrogation by endorsement or otherwise.
§ 11.3.6 Before an exposure to loss may occur, the Contractor shall file with the Owner through the Architect, two certified copies of the policy or policies providing this Property Insurance Coverage, each containing those endorsements specifically related to the Project.

§ 11.3.7 WAIVERS OF SUBROGATION
The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents and employees, each of the other, and (2) the Architect, Architect's consultants, separate contractors described in Article 6, if any, and any of their subcontractors, sub-subcontractors, agents and employees, for damages caused by fire or other causes of loss to the extent covered by property insurance obtained pursuant to this Section 11.3 or other property insurance applicable to the Work, except such rights as they have to proceed of such insurance held by the Contractor as fiduciary. The Owner or Contractor, as appropriate, shall require of the Architect, Architect's consultants, separate contractors described in Article 6, if any, and the subcontractors, sub-subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

§ 11.3.8 A loss insured under this property insurance shall be adjusted by the Contractor as fiduciary and made payable to the Contractor as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgage clause and of Section 11.3.10. 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 in similar manner.

§ 11.3.9 If required in writing by a party in interest, the Contractor as fiduciary shall, upon occurrence of an insured loss, give bond for proper performance of the Contractor's duties. The cost of required bonds shall be charged against proceeds received as fiduciary. The Contractor shall deposit in a separate account proceeds so received, which the Contractor shall distribute in accordance with such agreement as the parties in interest may reach, or as determined in accordance with the method of binding dispute resolution selected in the Agreement between the Owner and Contractor. If after such loss no other special agreement is made and unless the Owner terminates the Contract for convenience, replacement of damaged property shall be performed by the Contractor after notification of a Change in the Work in accordance with Article 7.

§ 11.3.10 The Contractor as fiduciary shall have power to adjust and settle a loss with insurers unless one of the parties in interest shall object in writing within five days after occurrence of loss to the Contractor's exercise of this power; if such objection is made, arbitrators shall be chosen as provided in Paragraph 15.4. The Contractor as fiduciary shall in that case make settlement with insurers or, in accordance with the directions of the arbitrators.

§ 11.3.11 In the event of partial occupancy or use in accordance with Paragraph 9.9, the Contractor shall notify the insurance company and obtain a “Use and Occupancy Waiver” such that the policy will not be invalidated by occupancy.

§ 11.3.12 All insurance policies shall contain a provision stating that coverages afforded under any of the aforesaid insurance policies shall not be cancelled or materially changed without at least thirty (30) days prior written notice to the Owner. On all Certificate forms, the words “endeavor to” and the remaining words beginning with “but failure to” shall be stricken from the cancellation notice provision.

§ 11.3.13 All insurance policies shall be underwritten with responsible insurance carriers with Best’s Rating of not less than A and X and otherwise satisfactory to the Owner and licensed to provide insurance in the state in which the project is located. Non-admitted carriers may be considered on an individual basis.

§ 11.4 PERFORMANCE BOND AND PAYMENT BOND
§ 11.4.1 The Contractor shall within ten (10) days after execution of the Contract execute, deliver to and file with the Owner, a good and sufficient bond to be approved by the Owner in a penal sum equal to the Contract price. Such bond shall be duly executed by a qualified corporate surety, conditioned upon the true and faithful performance of the Contract, and warranty work, and, in addition, shall provide that if the Contractor or its subcontractors fail to duly pay for any labor, materials, or other supplies used or consumed by such Contractor or its
subcontractor in performance of the Work contracted to be done, the surety will pay the same in an amount not exceeding the sum specified in the bond, together with interest as provided by law. Performance and payment bonds shall be on forms provided by the Owner and must be issued by qualified sureties as specified herein. The Performance Bond shall additionally guarantee that the Contractor shall remedy any omissions; correct any and all defects; and adjust and make operable all component parts of the work falling under the requirements of his Contract which may be called to his attention within a period of twenty-four (24) months following the Date of Completion established in the Letter of Acceptance.

The expense of all bonds shall be borne by the Contractor. If, at any time a surety on such a bond becomes irresponsible or loses its right to do business in the State of Colorado, the Owner may require another surety acceptable to the Owner, which the Contractor shall furnish within ten (10) days after receipt of written notice to do so.

§ 11.4.2 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK
§ 12.1 UNCOVERING OF WORK
§ 12.1.1 If a portion of the Work is covered contrary to the Architect’s request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect’s examination and be replaced at the Contractor’s expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be at the Owner’s expense. If such Work is not in accordance with the Contract Documents, such costs and the cost of correction shall be at the Contractor’s expense unless the condition was caused by the Owner or a separate contractor in which event the Owner shall be responsible for payment of such costs.

§ 12.2 CORRECTION OF WORK
§ 12.2.1 BEFORE OR AFTER SUBSTANTIAL COMPLETION
The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, whether discovered before or after Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect’s services and expenses made necessary thereby, shall be at the Contractor’s expense.

§ 12.2.2 AFTER SUBSTANTIAL COMPLETION
§ 12.2.2.1 In addition to the Contractor’s obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, or within such longer period of time as may be prescribed by law, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Owner or Architect to do so unless the Owner or Architect has previously given the Contractor a written acceptance of such condition. The Owner or Architect shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner or Architect fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.4.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of incomplete or defective Work noted on the Certificate of Substantial Completion shall commence at final payment.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.
§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction, whether completed or partially completed, of the Owner or separate contractors caused by the Contractor’s correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 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.

§ 12.3 ACCEPTANCE OF NONCONFORMING WORK
If the Owner prefers to accept Work that 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 Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS
§ 13.1 GOVERNING LAW
Venue for any dispute concerning the Contract shall be exclusively in the federal court located in Colorado or the state court located in Las Animas, Colorado.

§ 13.1.1 Any provision in the Contract Documents to the contrary notwithstanding, the obligations of Owner and Contractor, each to the other, under this Contract, shall survive the termination of this Contract and shall continue to be binding upon the parties after such termination and until such time as full performance of such obligations shall have been made.

§ 13.2 SUCCESSORS AND Assigns
§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to covenants, agreements and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make such an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner’s rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate such assignment.

§ 13.3 WRITTEN NOTICE
Written notice shall be deemed to have been duly served if delivered in person to the individual, to a member of the firm or entity, or to an officer of the corporation for which it was intended; or if delivered at, or sent by registered or certified mail or by courier service providing proof of delivery to, the last business address known to the party giving notice, or if sent via facsimile transmission to the party for whom it is intended.

§ 13.4 RIGHTS AND REMEDIES
§ 13.4.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights and remedies otherwise imposed or available by law, unless so indicated.

§ 13.4.2 No action or failure to act by the Owner, Architect or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed in writing, or specified in the Contract.
§ 13.5 TESTS AND INSPECTIONS
§ 13.5.1 Tests, inspections and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules and regulations or lawful orders of public authorities. 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. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of (1) tests, inspections or approvals that do not become requirements until after bids are received or negotiations concluded, and (2) tests, inspections or approvals where building codes or applicable laws or regulations prohibit the Owner from delegating their cost to the Contractor.

§ 13.5.2 If the Architect, Owner or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection or approval not included under Section 13.5.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection or approval by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.5.3, shall be at the Owner’s expense.

§ 13.5.3 If such procedures for testing, inspection or approval under Sections 13.5.1 and 13.5.2 reveal 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 Architect’s services and expenses shall be at the Contractor’s expense.

§ 13.5.4 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 Architect.

§ 13.5.5 If the Architect is to observe tests, inspections or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.5.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.6 INTEREST
Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at such rate as the parties may agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

§ 13.7 TIME LIMITS ON CLAIMS

Accrual dates for Statutes of Limitations are controlled by Colorado Law.

§ 13.8 EQUAL OPPORTUNITY
§ 13.8.1 The Contractor shall maintain policies of employment as follows:
§ 13.8.1.1 The Contractor and the Contractor’s Subcontractors shall not discriminate against any employee or applicant for employment because of race, religion, color, sex or national origin. The Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, religion, color, sex or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the policies of non-discrimination.

§ 13.8.1.2 The Contractor and the Contractor’s Subcontractors shall, in all solicitations or advertisements for employees placed by them or on their behalf, state that all qualified applicants will receive consideration for employment without regard to race, religion, color, sex or national origin.
§ 13.9 FIREARMS PROHIBITED
§ 13.9.1 No provider of services pursuant to this contract, including but not limited to employees, agents, suppliers or subcontractor’s of the Contractor shall carry or possess a firearm on the Owner’s premises or while acting on behalf of the Owner pursuant to the terms of this agreement. Violation of this provision shall be considered a substantial breach of the Agreement; and, in addition to any other remedy available to the Owner under law or equity. Violation of this provision is grounds for immediate suspension or termination of this contract.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 TERMINATION BY THE CONTRACTOR

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, for any of the following reasons:

.1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
.2 An act of government, such as a declaration of national emergency that requires all Work to be stopped;
.3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
.4 The Owner has failed to furnish to the Contractor promptly, upon the Contractor’s request, reasonable evidence as required by Section 2.2.1.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, repeated suspensions, delays or interruptions of the entire Work by the Owner as described in Section 14.3 constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days’ written notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, including reasonable overhead and profit, costs incurred by reason of such termination, and damages.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing portions of the Work under contract with the Contractor because the Owner has repeatedly failed to fulfill the Owner’s obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days’ written notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 TERMINATION BY THE OWNER FOR CAUSE

§ 14.2.1 The Owner may terminate the Contract if the Contractor

.1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
.2 fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;
.3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
.4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the above reasons exist, the Owner, upon certification by the Architect/Initial Decision Maker that sufficient cause exists to justify such action, may without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor’s surety, if any, seven days’ written notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

.1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
.2 Accept assignment of subcontracts pursuant to Section 5.4; and
.3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect’s services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Architect/Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 SUSPENSION BY THE OWNER FOR CONVENIENCE
§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay or interruption as described in Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

1. that performance is, was or would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible; or

2. that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 TERMINATION BY THE OWNER FOR CONVENIENCE
§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner’s convenience and without cause.

§ 14.4.2 Upon receipt of written notice from the Owner of such termination for the Owner’s convenience, the Contractor shall

1. cease operations as directed by the Owner in the notice;

2. take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and

3. except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner’s convenience, the Contractor shall be entitled to receive payment for Work executed, and costs incurred by reason of such termination, in accordance with the requirements of the Contract Document.

ARTICLE 15 CLAIMS AND DISPUTES
§ 15.1 CLAIMS
§ 15.1.1 DEFINITION
A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, or other relief with respect to the terms of the Contract. The term “Claim” also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim.

§ 15.1.2 NOTICE OF CLAIMS
Claims by either the Owner or Contractor must be initiated by written notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party must be initiated within 21 days after occurrence of the event giving rise to such claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.
§ 15.1.3 CONTINUING CONTRACT PERFORMANCE
Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents. The Architect will prepare Change Orders and issue Certificates for Payment in accordance with the decisions of the Initial Decision Maker.

§ 15.1.4 CLAIMS FOR ADDITIONAL COST
If the Contractor wishes to make a Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.5 CLAIMS FOR ADDITIONAL TIME
§ 15.1.5.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, written notice as provided herein shall be given. The Contractor’s Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.5.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated and had an adverse effect on the scheduled construction.

§ 15.1.6 CLAIMS FOR CONSEQUENTIAL DAMAGES
The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes
1. damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
2. damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party’s termination in accordance with Article 14. Nothing contained in this Section 15.1.6 shall be deemed to preclude an award of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 INITIAL DECISION
§ 15.2.1 Claims, excluding those arising under Sections 10.3, 10.4, 11.3.9, and 11.3.10, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim arising prior to the date final payment is due, unless 30 days have passed after the Claim has been referred to the Initial Decision Maker with no decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker’s sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner’s expense.
§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of such request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time.

§ 15.2.6 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor’s default, the Owner may, but is not obligated to, notify the surety and request the surety’s assistance in resolving the controversy.

§ 15.2.7 If a Claim relates to or is the subject of a mechanic’s lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 MEDIATION
§ 15.3.1 Notwithstanding any demand for mediation or arbitration that may be made by the Contractor, and not withstanding any provision herein, any controversy or claim in any event arising out of or related to the Contract or the alleged breach thereof shall, if the Owner so elects in its sole discretion, be litigated in a court of competent jurisdiction, rather than mediated or arbitrated as otherwise provided in this Contract. Nothing in the Contract Documents shall be construed to the effect that the requirements relating to mediation or arbitration shall in any way constitute the prerequisite to any legal or equitable proceeding initiated by the Owner in any court of competent jurisdiction.

(Paragraph Deleted)

§ 15.4 ARBITRATION
§ 15.4.1 In the event that it becomes necessary for either the Owner or Contractor to resolve any controversy or claim arising out of or related to the Contract through litigation, the prevailing party in such litigation shall be entitled to collect, as part of any judgement entered, its reasonable expert witness and attorney fees and costs.

(Paragraphs Deleted)

§ 15.4.2 CONSOLIDATION OR JOINER
§ 15.4.2.1 Either party, at its sole discretion, may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.2.2 Either party, at its sole discretion, may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an
additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.2.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as the Owner and Contractor under this Agreement.

§ 16.1 In compliance with Colorado Revised Statutes § 8-17-101 and 8-17-102, preference shall be given to Colorado labor shall be employed to perform at least eighty percent (80%) of the Work. The term “Colorado labor” means any person who is a resident of the State of Colorado at the time of the Project, without discrimination as to race, creed, color, sex, sexual orientation, marital status, age, religion, national origin, ancestry, disability or other legally protected class. A resident of Colorado is a person who can provide a valid Colorado driver’s license, a valid Colorado state-issued ID, or documentation that he or she has resided in Colorado for the last thirty (30) days. The Owner shall have the right, in its sole discretion, to waive the eighty percent (80%) Colorado labor requirement. To the extent Owner decides to waive this requirement, Contractor shall cooperate with Owner in providing all documents necessary to support a waiver.

In compliance with Colorado Revised Statutes § 8-19-101 and 8-19-102, preference shall be given to resident bidders against nonresident bidders from a state or foreign country equal to the preference given or required by the state or foreign country in which the nonresident bidder is a resident. The term “resident bidder” means a person, partnership, corporation, or joint venture that is (a) authorized to transact business in Colorado and maintains its principal place of business in Colorado; or (b) authorized to transact business in Colorado, maintains a place of business in Colorado, and has paid Colorado unemployment compensation taxes in at least six (6) of the eight (8) quarters immediately prior to bidding on the Work.

§ 16.2 During the performance of this Contract, the Contractor shall not discriminate against any employee or applicant for employment because of race, religion, color, gender, sexual orientation, national origin, veteran status or marital status. The Contractor shall take action to ensure that applicants are employed and that employees are treated during employment without regard to their race, religion, color, gender, sexual orientation, national origin, veteran status or marital status. Such action shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places available to employees and applicants for employment, notices setting forth the policies of nondiscrimination.

The Contractor shall be responsible to the District for the acts and omissions of all its agents and employees. The Contractor shall also be responsible for the acts and omissions of all its subcontractors and their agents and employees, and all other persons acting on behalf of the Contractor or subcontractors as set forth herein.

Contractor shall abide by all applicable District policies and procedures, including without limitation those related to the prohibited use and/or possession of alcohol, tobacco, or firearms on District grounds. The Contractor shall at all times strictly enforce this prohibition among its own employees, agents or subcontractor and their employees, agents, or subcontractors. Employees who violate these prohibitions shall be subject to disciplinary action by their employers up to and including termination, and may be denied access to the Project site. Violation of this provision shall also constitute sufficient grounds for termination of the Agreement or any subcontract, with damages or penalty to the District.

The Contractor shall certify to Owner that Contractor will not knowingly employ on Owner’s premises persons convicted of any felony or misdemeanor crime of unlawful sexual behavior involving children.

§ 16.2.1 Notify the subcontractor and Owner within three days that Contractor has actual knowledge that the subcontractor is employing or contracting with an illegal alien; and

Init.

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User Notes:
§ 16.2.2 Terminate the contract with the subcontractor if within three days of receiving actual notice the subcontractor does not stop employing or contracting with the illegal alien, except that Contractor shall not terminate the subcontractor if during such three days the subcontractor provides information to establish that the subcontractor has not knowingly employed or contracted with an illegal alien.

Contractor shall comply with any reasonable request by the Department of Labor and Employment (hereinafter referred to as the “Department”) made in the course of an investigation that the Department is undertaking pursuant to C.R.S. § 8-17.5-102(5). If Contractor violates the provisions of this subsection, Owner may terminate the Contract for breach and Contractor shall be liable for actual and consequential damages.

OWNER (Signature)

CONSTRUCTION MANAGER (Signature)

(Printed name and title)  (Printed name and title)
PART 1: GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Work covered by the Contract Documents.
2. Owner-furnished products.
3. Use of premises.
4. Owner’s occupancy requirements.
5. Punchlist Completion.
6. Work restrictions.
7. Specification formats and conventions.

1.02 PROJECT IDENTIFICATION

A. Project Name: Alice Terry Elementary Improvements, Englewood, Colorado

B. Owner: Sheridan School District #2
4150 South Hazel Court
Englewood, Colorado 80110

C. Architect: Wold Architects and Engineers
1553 Platte Street, Suite 201
Denver, Colorado 80202

D. Mechanical Engineer: BranchPattern
Johns Manville Plaza
717 17th Street, Suite 1500
Denver, Colorado 80202

E. Electrical Engineer: BranchPattern
Johns Manville Plaza
717 17th Street, Suite 1500
Denver, Colorado 80202

1.03 SUMMARY OF THE WORK

Briefly and without force and effect upon the Contract Documents, the Work of this single prime Contract can be summarized as follows:

A. Work under this Contract includes:

1. Interior Finishes
   a. Insulated gypsum board/metal stud partitions and brick.
   b. Floor finishes of carpet, LVT, and porcelain tile.
   c. Wall finishes of paint and ceramic tile.
d. Ceiling finishes of acoustical lay-in tile and gypsum board soffits.

e. HM doors and frames, access panels, hardware, toilet partitions, toilet accessories, miscellaneous specialties.

2. Mechanical Systems

a. Plumbing including, supply and waste piping systems, piping insulation, plumbing fixtures.

b. Temperature control system modifications.

3. Electrical Systems

a. Electrical service, switchgear, distribution panels, conduit, and wiring.

b. Interior and exterior lighting.

c. Low voltage work, including new data outlets.

d. Fire alarm modifications.


1.04 USE OF PREMISES

A. General: Contractor shall have limited use of premises for construction operations as indicated on Drawings by the Contract limits.

1. Contractor is to visit site and be familiar with existing conditions. Contractor will be required to accept existing conditions on site prior to mobilizing.

B. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Allow for Owner occupancy of Project site and use by the public.

2. Driveways and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to Owner, Owner’s employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

   a. Schedule deliveries to minimize use of driveways and entrances.
   
   b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

3. Public Streets: Maintain clear of automobile parking, equipment or material storage unless arrangements have been made with the appropriate jurisdiction.

4. Lock automotive type vehicles, such as passenger cars and trucks and other mechanized or motorized construction equipment, when parked and unattended, so as to prevent unauthorized use. Do not leave such vehicles or equipment unattended with the motor running or the ignition key in place.

C. Do not allow construction waste and debris to accumulate; remove debris as it accumulates and, unless specified otherwise, dispose of legally off-site.

D. Conform to City's noise control regulations, including limited hours of construction operations.
E. Use of Existing Building: Maintain existing building in a weathertight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

1.05 LAYING OUT WORK

A. Locate all general reference points. Where dimensions or observed scope of work differ substantially from Drawings, notify Architect for decision.

B. Lay out Work from the reference points furnished and be responsible for all lines, elevations, and measurements inside workspace. Exercise proper precaution to verify figures shown on Drawings before laying out work and will be held responsible for any error resulting from his failure to exercise such precaution.

C. Hire the services of a locator company to locate all privately owned utilities that may be disturbed by construction operations.

D. Coordinate utility connections with municipality/utility company in which project is being constructed.

1.06 OWNER’S OCCUPANCY REQUIREMENTS

A. Full Owner Occupancy: Owner will occupy portions of the site and existing building during a portion of construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner’s day-to-day operations. Maintain existing exits, unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.

2. Provide not less than 72 hours’ notice to Owner of activities that will affect Owner’s operations.

B. Owner Occupancy of Completed Areas of Construction: Owner reserves the right to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.

1. Architect will prepare a punchlist for each specific portion of the Work to be occupied before Owner move in.

2. Obtain a temporary Certificate of Occupancy if required from authorities having jurisdiction before Owner occupancy to install furnishings and equipment.

1.07 WORK RESTRICTIONS

A. The Contractor shall limit access to grounds as indicated on Civil Drawings.

B. The Contractor’s access to and use of the site/facility for completion of work shall be subject to the following:

1. Should the Contractor have additional work to complete after August 9, 2019, including punchlist work within the existing building, continuous use of facilities is required by the Owner during regular business hours of 8:00 a.m. to 3:30 p.m. Work in those areas shall occur during evenings and weekends and shall be cleaned and available for use the following school or business day. Coordinate with building staff on what limitations they may have on the work (noise, building access, etc.). Contractors shall maintain clean working environments at all times.

2. Should the Contractor begin work within the existing building prior to May 23, 2019, continuous use of facilities is required by the Owner during regular business hours of 8:00 a.m. to 3:30 p.m. Coordinate with building staff on what limitations they may have on the work (noise, building access, etc.).
3. Should the Contractor choose to perform work after normal business hours when the building is occupied, the Contractor shall:
   a. Maintain access, building utilities, and services to allow full and free use of the facility during this time. All temporary conditions, re-routing of services, utilities and/or power are the Contractor’s responsibility.
   b. Coordinate access and storage of materials and equipment with the Owner’s designated building representative. To the fullest extent possible provide for normal building operation, and the safety of the building’s occupants. Work in areas that occur during evenings and weekends shall be cleaned and available for use the following business day.

4. Coordinate schedule with the Owner’s designated building representative; keep Architect informed.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Architect not less than seven (7) days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Architect’s or Owner’s permission.

1.08 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Division and Sections using the 49-division format and CSI/CSC’s “Master Format” numbering system.
   1. Division 1: Sections in Division 1 govern the execution of the Work of all Sections in the Specifications.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
   1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
   2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
      a. The words “shall,” “shall be,” or “shall comply with,” depending on the context, are implied where a colon (:) is used within a sentence or phrase.

END OF SECTION 01 11 00
SECTION 01 23 00

ALTERNATES

PART 1: GENERAL

1.01 DESCRIPTION

A. This Section describes the limits of the requested alternates to the Contract work. Refer to the Product/Execution Articles of the appropriate Specifications and the Drawings for information pertaining to the work of each alternate.

B. Each proposal under an alternate shall include all incidental work and all adjustments necessary to accommodate the changes. All work shall meet the requirements of the Drawings, Specifications and appropriate details.

C. Submit each alternate proposal as an individual cost for the particular alternate and shall be proposed under the premise that no other alternates have been accepted. Should the work of an alternate called for by the Bid Form not affect the cost of the work, state "No Change" in the space provided. If an alternate is left blank, the Owner reserves the right to throw out the entire bid or interpret the alternate as "No Change".

D. Include taxes which are applicable to work involved in alternates as well as costs, if any, for increased coverage of bonds and insurance.

E. Any of the alternates may be accepted by Owner and will be used in determining the low bidder.

F. Owner may, at their option, vary the scope of the work by authorizing alternates which will add to the work, deduct from the work or substitute materials, equipment, or methods.

G. Each Bidder shall examine the Drawings and Specifications to determine the extent to which their work is affected by bid alternates. Include in the space provided on the bid form the cost of any added or deducted work resulting from each alternate.

H. Contractor is responsible for providing work if applicable to each alternate, whether or not an added or deducted cost is included on their bid form.

PART 2: EXECUTION

2.01 IMPLEMENTATION

A. If the Owner elects to proceed on the basis of one or more of the alternates, make all modifications to the Work required in the furnishing and installation of the selected alternate or alternates subject to the approval of the Architect at no additional cost to the Owner except as proposed in the Bid.

B. Coordinate pertinent related work and modify surrounding work as required to properly integrate the work under each alternate, and to provide the complete construction required by Contract Documents.

C. If so stated in the Agreement, or modifications thereto, provide alternate materials, equipment and/or construction, as specified.
2.02 ALTERNATES

A. Alternate #1: Floor Drains
   1. Provide floor drains at renovated toilet rooms, per drawings.

B. Alternate #2: LVT Flooring
   1. Provide LVT flooring at corridors, per drawings.

C. Alternate #3: Urinal Replacements
   1. Replace existing waterless urinals with flush urinals, per drawings.

END OF SECTION 01 23 00
PART 1: GENERAL

1.01 DESCRIPTION

A. This Section defines procedures to be followed to gain acceptance of products in the Work which are not listed in the individual specification sections. A two step process is required.

B. Requests for acceptance for bidding purposes of alternative manufacturers is encouraged except where specifically prohibited by this Project Manual.

C. Submit Prior Approval request via email to mail@woldae.com with the following information in the subject line: Prior Approval 195015, XX XX XX (Specification Section).

1.02 PRODUCT OPTIONS NOT REQUIRING PRE-BID SUBMITTAL

A. Where a single manufacture is specified and acceptable manufacturer are also listed, acceptable manufacturers must provide an identical product or accept responsibility for all design implications when providing a product other than the specified product.

B. Where products are specified by reference standards, any product established by a material testing agency to meet these standards is acceptable.

C. Where multiple manufacturers and associated models are specified, select any one named.

D. Where manufacturer(s) alone are specified, select any manufacturer and the product recommended in writing by the manufacturer as most suited to the application shown on the Drawings and Specifications.

E. Where the phrase "or equal" follows the name of a manufacturer, any product which meets the performance and appearance standards established by the specified manufacturer may be selected, subject to the Architect's acceptance.

F. Where a manufacturer is listed in both a technical specification section and the Material Finish/Color Schedule, a color is provided.

1.03 PRODUCT SUBSTITUTIONS REQUIRING PRE-BID SUBMITTALS

A. Step One - Manufacturers Acceptance

1. Individual specification sections may be amended by the Architect during the bid period to include additional names of manufacturers determined to be capable of providing acceptable materials.

2. The Material Finish/Color Schedule, on Architectural Drawings or Specifications may be amended by the Architect during the bid period to include colors by manufacturers listed in technical sections, but not noted on the Material Finish/Color Schedule, on Architectural Drawings or Specifications.
3. To propose the names of specific manufacturers, submit, or arrange for suppliers to submit, written requests to Architect or appropriate Architect's Consultant. Requests received ten (10) calendar days prior to bid date will be considered.

   a. Provide sufficient review data. Include specified manufacturer's model numbers and proposed manufacturer's product literature, noting product numbers for proposed substitutions, and where appropriate, samples and data relating to construction details. If the product is not identical to specified product, submit letter stating proposed manufacturer will custom make products to meet specified product.

   b. Architect's acceptance is based upon his determination that a manufacturer is capable of supplying acceptable materials. Approval is not assured or implied for a specific material, item of equipment, color or finish.

   c. Official notification will be by addendum to the Contract Documents. However, in addition, if letters of request are delivered in duplicate with accompanying stamped self addressed envelopes, copies may be returned with Architect's decision in advance.

B. Step Two - Product Acceptance

1. Upon award of a construction contract, accepted manufacturers may submit for review to the Architect through the General Contractor or Construction Manager, specific products, materials or equipment items as substitutes for those specified. Contractor to provide letter stating they will reimburse Architect to review substitutions.

2. Architect will review substitute products for performance, appearance, color, finish, size and suitability for inclusion in the work. If a substitute product is not accepted, submit another product by the same or other accepted manufacturer or provide the specified product.

3. Match specified colors and dimensions exactly, whether or not they are standard with the substitute product, unless a minor variation is accepted by the Architect.

4. If a substitute product is accepted, coordinate any necessary changes in other related work and pay for these changes. Pay cost of architectural or engineering services, if any, required to incorporate substitute products in the Work.

1.04 SUBSTITUTIONS BY CHANGE ORDER

A. A substitution for a specified product may be permitted by "change order" at no additional cost to the Owner if product proposed is determined to be equivalent in performance and suitability, and if at least one of the following conditions apply:

1. Owner is given a credit for the work.

2. Product is of superior quality than product specified.

3. Product color or finish selection is preferable.

4. Products specified and upon which building is designed have been discontinued by manufacturer.

B. Provide Architect, through Owner, reasonable compensation for product evaluation.

END OF SECTION 01 25 00
SECTION 01 26 63

CHANGE ORDERS

1.01 CHANGE ORDER PROCEDURES

A. Changes in the Project scope of work affecting the project cost can be made only through AIA Document G701 - Change Order.

B. The procedures for processing changes in the scope of Work are listed as follows:

1. The Architect prepares one of the following documents to modify the scope of work. Documents and attachments revising the drawings and specifications will be distributed electronically and the Contractor will be responsible for printing.
   a. Supplemental Instructions (SI) which are used for no cost changes.
   b. Proposal Request (PR) to be used for proposed changes that need written approval on cost prior to proceeding.
   c. Construction Change Directive AIA Document G714 (CCD) which is used when the work must proceed immediately and time and material cost submitted as soon as possible for review by the Architect.

2. The Contractor reviews and responds as follows:
   a. Supplemental Instructions (SI): This no cost change is to be carried out in accordance with the following modifications to the contract documents described herein. If this change effects cost, do not proceed with this change. Notify the Architect in writing within 10 days of receipt that an itemized (labor and material) quotation will be submitted within 21 days of initial receipt of this Supplemental Instruction. If a cost is not submitted within 21 days, this Supplemental Instruction will be accepted at no additional cost.
   b. Proposal Request (PR): Submit an itemized (labor and material) quotation for the proposed modifications to the contract documents as described herein within 21 days of receipt. If a cost is not submitted within 21 days, this Proposal Request can be accepted at no additional cost. Written approval is required prior to proceeding with this change.
   c. Construction Change Directive AIA Document G714 (CCD): Proceed immediately to carry out this change in the contract documents as described herein. If this revision effects cost, submit an itemized (labor and material) quotation within 21 days of receipt. If a cost is not submitted within 21 days this Change Directive will be accepted at no additional cost.

3. The Architect will review the Contractor’s labor and material itemized quotation and respond in writing whether it is acceptable or needs revision. When all pricing is accepted by the Architect and Owner, a Change Order will be processed. Change Orders will be processed at increments determined by the Architect throughout the construction schedule.

C. See General Conditions and Supplementary Conditions of the Work for methods of determining cost or credit, mark-up and schedule on submitting claims.
SECTION 01 31 19

PROJECT MEETINGS

PART 1: GENERAL

1.01 DESCRIPTION

A. Schedule and administer pre-construction meeting, periodic progress meetings, and specially called meetings throughout the progress of the work.
   2. Prepare agenda for meetings.
   3. Make physical arrangements for meetings.
   4. Preside at meetings.

B. Representatives of contractors, subcontractors and suppliers attending the meetings shall be qualified and authorized to act on behalf of the entity each represents.

C. Architect may attend meetings to ascertain that Work is expedited consistent with Contract Documents and the construction schedules.

1.02 PRE-CONSTRUCTION MEETING

A. Schedule within 15 days after date of Notice to Proceed.

B. Location: A central site, convenient for all parties, designated by Contractor.

C. Attendance:
   1. Owner's representative
   2. Architect and their professional consultants
   3. Resident Project representative
   4. Contractor's superintendent
   5. Major subcontractors
   6. Major suppliers
   7. Others as appropriate

D. Suggested Agenda:
   1. Distribution and discussion of:
      a. List of major subcontractors and suppliers
      b. Projected construction schedules Refer to Section 01 32 00
         - Critical Path Method, Schedule for entire construction period
• Submittal Schedule
  • Schedule pre-scheduling conference.

2. Critical work sequencing.

3. Major equipment deliveries and priorities.

4. Project coordination and scheduling:
   a. Designation of responsible personnel.
   b. Pre-installation conference.
      • Tile
      • Floor finishes (carpet, tile, etc.)
      • Dust control

5. Procedures and processing of:
   a. Field decisions
   b. Proposal Requests/Supplemental Instructions
   c. Submittals, Overall
      1) Including Mechanical / Electrical Coordination drawings
   d. 21 day time limit on claims
   e. Change orders
   f. Applications for payment


7. Procedures for maintaining Record Documents.

8. Use of premises:
   a. Office, work, and storage areas
   b. Owner’s requirements

9. Steel fabrication certification. Refer to 05 12 00 – 1.06 B, C.

10. Construction facilities, controls, and construction aids.
   a. Construction Dust Control. Refer to Spec 01 56 00
      • Submit work area and procedures schedule
      • Dust proof enclosures
      • HEPA filters vacuums
      • Maintain negative air flow
      • Dust control by spraying surfaces with watermist
      • Enforcement per spec. Written warning, if not corrected in 8 hours, Owner will stop work, Cost will be borne by Contractor
11. Temporary utilities.


14. Housekeeping procedures, Refer to Spec Section 01 50 00.
   - Debris removed weekly
   - Daily cleaning requirements
   - Failure to maintain clean site will result in Owner cleaning and back charging Contractor

15. Final Cleaning, Refer to Spec Section 01 74 00.
   - Schedule in time for Owner to complete furniture installation, required clean (i.e. floors)
   - Any cleaning done by Owner due to unacceptable cleaning by Contractor, or to and contractor in completing cleaning on schedule will be back charged to Contractor

1.03 PROGRESS MEETINGS

A. Schedule regular periodic meetings, as required.

B. Hold called meetings as required by progress of the work.

C. Location of the meetings: The project field office of the Contractor.

D. Attendance:
   1. Architect and their professional consultants may attend as needed.
   2. Subcontractors as appropriate to the agenda.
   3. Suppliers as appropriate to the agenda.
   4. Others.

E. Suggested Agenda:
   1. Review, approval of minutes of previous meeting.
   2. Review of work progress since previous meeting.
   3. Field observations, problems, conflicts.
   4. Problems which impede Construction Schedule.
   5. Review of off-site fabrication, delivery schedules.
   6. Corrective measures and procedures to regain projected schedule.
   7. Revisions to Construction Schedule.
   8. Plan progress, schedule, during succeeding work period.
   9. Coordination of schedules.
   10. Review submittal schedules; expedite as required.

12. Review proposed changes for:
   a. Effect on Construction Schedule and on completion date.
   b. Effect on other contracts of the Project.

13. Other business.

END OF SECTION 01 31 19
SECTION 01 31 26

ELECTRONIC COMMUNICATION PROTOCOLS

PART 1: GENERAL

1.01 SUMMARY

A. The Architect will provide the Contractor with one (1) electronic copy of the background drawing relevant to their request. Requested files will be provided via email to the Contractor in AutoDesk AutoCAD format.

B. The terms and conditions on the attached form “Agreement Between Architect and Contractor for Transfer of Computer Aided Drafting (CAD) Files on Electronic Media” apply to all Electronic Documents issued by Wold Architects and Engineers or its consultants for the project.

1. Exceptions:
   a. Electronic Documents by other consultants on the project may need to sign an additional Agreement for Electronic File Transfer that can be made available upon request.

C. Electronic Document Availability

   1. Pre Bid: AutoCAD backgrounds pertaining only to Survey and/or proposed grading will be available prior to bid. Requesting Contractors must complete “Attachment A - Agreement Between Civil Engineer and Contractor for Transfer of Computer Aided Drafting (CAD) Files on Electronic Media” at time of request.

   2. After Bid: Backgrounds as requested by the awarded contractors at the discretion of the Architect or Engineer. Electronic Documents are available upon completion of “Attachment A - Agreement Between Architect and Contractor for Transfer of Computer Aided Drafting (CAD) Files on Electronic Media” by the General Contractor on project.

D. See attached form “Attachment A – Agreement Between Architect and Contractor for Transfer of Computer Aided Drafting (CAD) Files on Electronic Media.”

PART 2: PRODUCTS – (Not Applicable)

PART 3: EXECUTION – (Not Applicable)

END OF SECTION 01 31 26
ATTACHMENT A – AGREEMENT BETWEEN ARCHITECT AND CONTRACTOR FOR THE TRANSFER OF COMPUTER AIDED DRAFTING (CAD) FILES ON ELECTRONIC MEDIA FOR:

ALICE TERRY ELEMENTARY IMPROVEMENTS

The purpose of this agreement is to grant permission from the Transmitting Party (Architect and/or Engineer) to the Receiving Party (Contractor, Bidder, and/or Construction Manager) for the Receiving Party’s use of Electronic Media on the Project, and to set forth the terms of such use. Electronic Media is defined to include all data or files transmitted. All Electronic Media is considered confidential and containing business proprietary information. Wold Architects & Engineers and its consultants grant the Receiving Party a limited license to use Electronic Media issued by Wold Architects & Engineers exclusively for this Project. The terms are set forth as follows:

1. The Electronic Media is transmitted for the Receiving Party’s convenience and remains the sole property of Wold Architects and Engineers and/or its consultants.
2. The Transmitting Party makes no warranty, expressed or implied, including warranties of merchantability or fitness for a particular purpose, respecting the Electronic Media or the files therein. The Transmitting Party makes no representation regarding the accuracy, completeness, or permanence of the Electronic Media or the files therein.
3. The Electronic Media or files therein depict information only at the specific point in time of preparation and may not include final data or represent exact as-built conditions. Addenda information or revisions made after the date indicated on the files may not have been incorporated. The Receiving Party is solely responsible for verifying all field conditions against the Electronic Media or files therein and making all necessary adjustments. The Receiving Party is solely responsible for determining whether any changes made after it receives the Electronic Documents affect any services or work it provided using the Electronic Documents and for updating any such services or work.
4. The Electronic Media and files therein are not considered to be Contract Documents as defined by the General Conditions of the Contract for Construction. In the event of a conflict between the Architect’s and/or Engineer’s sealed Contract Drawings and the Electronic Media files, the sealed Contract Drawings shall govern. It is the Receiving Party’s responsibility to determine if any conflicts exist.
5. Neither Wold Architects and Engineers nor its consultants are responsible for any decline in accuracy or readability due to the medium on which the Electronic Media are stored, or for any unintentional transmission of computer viruses.
6. The Electronic Media and the files therein may not be used by the Receiving Party for any purpose other than as a convenience in the preparation of Shop Drawings, layout, and other purposes related to the Project. Any use or reuse of the Electronic Media of the files therein, by the Receiving Party or others, are at the Receiving Party’s sole risk and without liability or legal exposure to the Architect, Engineers, or their consultants.
7. The Architect reserves the right to determine what content will be distributed to the Receiving Party.

By signing below, the Receiving Party agrees to the terms set for by this Agreement.

AUTHORIZED ACCEPTANCE:

By Receiving Party/Contractor of Record

________________________________________
Signature

________________________________________
Print Name and Title

________________________________________
Print Name of Company

________________________________________
Date
SECTION 01 32 00
CONSTRUCTION SCHEDULING

PART 1: GENERAL

1.01 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Contractor’s Construction (CPM) Schedule.
2. Shop Drawing Submittals Schedule
3. CPM Reports

1.02 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
2. Predecessor activity is an activity that must be completed before a given activity can be started.

B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

C. Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall Project duration and contains no float.

D. Event: The starting or ending point of an activity.

E. Float: The measure of leeway in starting and completing an activity.

1. Float time is for the exclusive use or benefit of the Contractor to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

F. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

G. Major Area: A story of construction, a separate building, or a similar significant construction element.

H. Milestone: A key or critical point in time for reference or measurement.

I. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.
1.03 SUBMITTALS

A. Submittals Schedule: Submit six copies of schedule. Arrange the following information in a tabular format:

1. Scheduled date for first submittal.
2. Specification Section number and title.
3. Submittal category (action or informational).
4. Name of subcontractor.
5. Description of the Work covered.
6. Scheduled date for Architect’s final release or approval. (Assume 15 working day turnaround.)
7. Identify submittals that affect critical path.

B. Contractor’s Construction (CPM) Schedule: Submit two printed copies of initial schedule large enough to show entire schedule for entire construction period.

C. CPM Reports: Concurrent with CPM schedule, submit three printed copies of the following computer-generated reports. Format for each activity in reports shall contain activity number, activity description, original duration, early start date, early finish date, late start date, late finish date, and total float.

1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.

1.04 QUALITY ASSURANCE

A. Prescheduling Conference: Conduct conference at Project site to review methods and procedures related to the Contractor’s Construction (CPM) Schedule, including, but not limited to, the following:

1. Discuss constraints, including phasing, work stages, area separations, interim milestones and partial Owner occupancy.
2. Review delivery dates for Owner-furnished products.
3. Review schedule for work of Owner’s separate contracts.
4. Review time required for review of submittals and resubmittals.
5. Review requirements for tests and inspections by independent testing and inspecting agencies.
6. Review time required for completion and startup procedures.
7. Review and finalize list of construction activities to be included in schedule.
8. Review submittal requirements and procedures.
9. Review procedures for updating schedule.

1.05 COORDINATION

A. Coordinate requirements in this Article with “Submittals Schedule” Article in Part 2. If a submittal review sequence policy governs, revise this Article to comply with requirements. See Evaluations for discussion on submittal review sequence policies.

PART 2: PRODUCTS

2.01 SUBMITTALS SCHEDULE

A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates. Identify items that affect critical path.

2.02 CONTRACTOR’S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. General: Prepare network diagrams using CPM (critical path method) format.
B. Preliminary Network Diagram: Submit diagram within 14 days from the Notice to Proceed. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

C. CPM Schedule: Prepare Contractor’s Construction Schedule using a CPM network analysis diagram.

1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted prior to first pay request.

2. Establish procedures for monitoring monthly and updating CPM schedule if work is not on schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.

3. Use “one workday” as the unit of time. Activities should not be shorter than 2 work days or longer than 10 work days for projects with a construction period over 6 months and/or longer than 5 work days for projects with a construction period under 6 months.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
   a. Preparation and processing of submittals.
   b. Purchase of materials.
   c. Delivery.
   d. Fabrication.
   e. Installation.

2. Processing: Process data to produce output data or a computer-drawn, logic network diagram. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.

PART 3: EXECUTION

3.01 CONTRACTOR’S CONSTRUCTION SCHEDULE

A. Contractor’s Construction Schedule Updating:

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.

B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.

2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.
SECTION 01 33 00

SUBMITTALS

PART 1: GENERAL

1.01 DESCRIPTION

A. This Section defines procedures for the following submittals required by the Contract Documents.

B. Provide submittals as noted in each Section.

C. Allow for two weeks review of submittals to avoid delay of Work.

D. Include with submittal preparation, field verifications of measurements, field construction criteria, verification of catalog numbers and similar data, and coordination of Work requirements and Contract Documents.

E. Submit all color samples within 45 days of contract award for Architect's use in color selections. The Architect will not start the color schedule until all samples are received.

PART 2: REQUIRED SUBMITTALS

2.01 SHOP DRAWINGS AND SAMPLES

A. Submit shop drawings in accordance with Article 3 of the General Conditions and the following.

B. Prepare clearly identified shop drawings or schedules to this specific project, containing only data applicable. Include with the shop drawings or schedules a letter of transmittal listing and dating the submitted drawings in sets.

C. Contractor to review all submittals prior to submittal to Architect, and indicate such review with a stamp and signature. Review submittals for conformance to Drawings, Specifications, coordination with other trades and adjacent construction and verification of field dimensions. Failure of Contractor to adequately review submittals shall be cause for rejection.

D. Prepare and submit electronically (with exception for color charts and samples) to Architect for review, all shop drawings and manufacturers catalog sheets showing illustrated cuts of items to be furnished, scale details, sizes, dimensions, performance characteristics, capacities, wiring diagrams, weights and arrangements. Each submittal to include a transmittal on contractor letterhead. Submittal to be in the form of one combined PDF, professionally assembled so all documents are facing the same way.

1. The Contractor will provide submittals labeled as follows:
   a. 195015, ATE, [PROJECT NAME ABBREVIATION], XX-XX-XX-X [SPECIFICATION # AND CONSECUTIVELY NUMBERED SUBMITTAL] [SPECIFICATION NAME] [SPECIFICATION NAME] [SUBMITTAL NAME].

   [Example: 142118, JHS, 04 20 00-1, Non-Bearing Masonry – Masonry Accessories]

E. Reproduction or exact replication of contract documents are not an acceptable form of shop drawings. Contractor is to generate shop drawings based on the information identified in the contract documents and notify the architect of discrepancies in the documents.

F. The Architect will take one of the following actions on submittals:

1. “Reviewed”: Contractor shall proceed with ordering and/or fabrication.
2. “Review Comments”: Contractor shall proceed with ordering and/or fabrication after taking into account noted comments.

3. “Rejected”: Contractor shall provide a submittal that meets the intent of the specifications.

4. “Revise and Resubmit”: Contractor shall modify submittal to address comments and resubmit.

G. If equipment other than that used in the design of this project is proposed to be used, the Contractor and/or supplier shall verify electrical differences, dimension variations and weight increases. The Contractor shall be responsible for any extra costs incurred as a result of equipment substitutions.

H. Information submittals and submittals that are not required shall be for Architects’ and Engineers’ use and be available for the design team’s review at the jobsite. Quantity of submittals will be the same for Architect as noted under shop drawings. These submittals will not be reviewed, stamped or returned to the Contractor.

I. Unless otherwise specified, submit to the Architect’s office samples of size, and nature representing typical qualities. Where required, submit a sufficient number of samples to demonstrate the complete range of variations of the material or quality. Written acceptance of the Architect is required prior to ordering any item for which samples are required.

J. Submit samples to Architect’s office, securely packaged, with the name of the Project clearly indicated on the package exterior. Each physical sample shall have a label or tag, firmly attached to the sample, bearing the following information: (a) Name of Project, (b) Name of Supplier, (c) Name of Contractor, and (d) Product information such as manufacturer’s designation, finish, type, class, grade, etc. as is appropriate. The Architect will retain one copy of each sample.

2.02 LIST OF MATERIALS

A. Within 7 days after the award of the Contract (notice to proceed or letter of intent), submit 4 copies of a complete list of all material, products, and equipment proposed to be used in construction to the Architect for acceptance. Do not order materials until the proposed listed materials, products and equipment to be used in construction are accepted by the Architect.

B. Where two or more makes or kinds of items are named in the specifications (or additional names are called for in addenda), the Contractor shall state which particular make or kind of each item he proposes to provide. If the Contractor fails to state a preference, the Owner shall have the right to select any of the makes or kinds named without change in price.

C. This list shall be arranged generally in order of specification sections. The items listed shall fully conform to project requirements and specifications. All materials are subject to the Architect’s acceptance. After acceptance, changes or substitutions will not be permitted.

D. Clearly identify or list the material, product or equipment by manufacturer and brand by listing the names for all items, including those where only one material or product is specified. Each and every material, product and equipment shall be specifically named, not listed "as specified".

2.03 LIST OF SUBCONTRACTORS

A. Refer to the General Conditions of the Contract for Construction.

B. Propose use of subcontractors or sub-subcontractors who are established, reputable firms of recognized standing with a record of successful and satisfactory past performance. Include the following information: specification section, item of work, subcontractor or supplier, material/manufacturer (as specified will not be allowed), project manager, phone and facsimile numbers. List major sub-subcontractors for mechanical and electrical work. Use only those subcontractors (and sub-sub-contractors, when appropriate) who are acceptable to the Architect and Owner on the Work.
2.04 SCHEDULE OF VALUES

A. Requirements

1. Submit separate Schedule of Values for each building or phase to Architect ten (10) days prior to first Application For Payment (AIA Form G702, G702a).

2. Use Schedule of Values only as basis for Contractor's Application For Payment.

B. Form of Submittal

1. Base format on Sections listed in Section 00 01 10 Table of Contents, as well as, the Mechanical and Electrical Table of Contents. Break down labor and material separately.

2. Provide a separate line item on the schedule of values for coordination drawings as defined in Division 23 Specification Section 23 05 00 “Common Work Results for HVAC”.

3. Round off amounts to nearest ten dollars.

2.05 PROGRESS SCHEDULE

A. Refer to the General Conditions of the Contract for Construction and Section 01 32 00 Construction Scheduling for submittal requirements.

2.06 COORDINATION DRAWINGS

A. Refer to Common Work Results in Mechanical and Electrical Specifications.

B. Prior to construction occurring above grade plane, submit Mechanical/Electrical Coordination Drawings for design team review.

2.07 SUBMITTAL LIST

A. The following submittal list is a guide for submittals required for specification divisions 2-14 on the project. Inconsistencies or omissions from the list does not relieve the contractor from required submittals delineated in each specification section.

<table>
<thead>
<tr>
<th>Section</th>
<th>05 50 00</th>
<th>06 10 00</th>
<th>07 21 00</th>
<th>07 51 15</th>
<th>07 92 00</th>
<th>09 21 16</th>
</tr>
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END OF SECTION 01 33 00
PART 1: GENERAL

1.01 SELECTION AND PAYMENT
A. The Owner will select, hire and pay for services of an independent testing laboratory to perform specified field quality control and other inspections, tests of materials and construction that is called for in the Specifications.

1.02 RESPONSIBILITY OF CONTRACTOR
A. Be responsible for furnishing materials and construction in full conformance with Plans and Specifications.
B. Pay for all tests, conducted by the testing laboratory that fail and also pay for all scheduled tests for which the pours are cancelled and a test field crew is on site before that particular pour is cancelled.

1.03 COOPERATION OF CONTRACTOR
A. Contractor: Cooperate with the Laboratory, and:
   1. Make available, without cost, samples of all materials to be tested in accordance with applicable standard specifications.
   2. Furnish such nominal labor and working space as is necessary to obtain samples at the Project.
   3. Advise Laboratory of the identity of material sources and instruct the suppliers to allow test or inspections by the Laboratory.
   4. Notify Laboratory sufficiently in advance of operations to allow completion of initial tests or inspections by the Laboratory.

1.04 REJECTION OF MATERIALS/INSTALLATION
A. Laboratory: Notify the Owner, Architect Engineer and Contractor or his authorized representative of any materials or installation which are not in full conformance with the specifications.

1.05 FILING OF REPORTS
A. Laboratory: File a copy of the inspection report with the Architect, appropriate Architect's Consultant, Owner and Building Official.

PART 2: PRODUCTS – Not Applicable.

PART 3: EXECUTION

3.01 GENERAL SCOPE OF TESTING, INSPECTION
A. Require laboratory to conduct tests and inspections as directed by the Owner, Architect, or Engineer.
B. Refer to individual specification sections for test requirements.
3.02 QUALIFICATION TESTING

A. In addition to tests specified, if a product, material, or method of assembly that is of unknown or questionable quality to Architect, the Architect may require and order suitable tests to establish a basis for acceptance or rejection. Pay for these tests. "Standard" test reports or reports on "similar" material will not be accepted.

3.03 MISCELLANEOUS (REGULATORY) INSPECTIONS

A. Should specifications, Architect's instructions, laws, ordinances or any public authority require any work to be inspected or approved, Contractor shall give timely notice of its readiness for inspection and a reasonable date fixed for such inspection. If any work should be covered up without approval or consent of approving agency, or Architect, it must be uncovered for examination at Contractor's expense.

END OF SECTION 01 45 16
PART 1: GENERAL

1.01 SUMMARY

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

B. Support facilities include, but are not limited to, the following:

1. Temporary roads and paving.
2. Dewatering facilities and drains.
3. Project identification and temporary signs.
4. Housekeeping and waste disposal facilities.
5. Field offices.
6. Construction aids and miscellaneous services and facilities.
7. Temporary heating, cooling, and ventilation.
8. Temporary power and lighting.

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

1. Environmental protection.
2. Stormwater control.
3. Tree and plant protection.
4. Pest control.
5. Site enclosure fence.
7. Barricades, warning signs, and lights.
8. Temporary enclosures.
9. Temporary partitions.
10. Fire protection.

1.02 DEFINITIONS

A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weather-tight; exterior walls are insulated and weather-tight; and all openings are closed with permanent construction or substantial temporary closures.

1.03 USE CHARGES

A. General: Cost or use charges for temporary facilities are not chargeable to Owner or Architect and shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:

1. Occupants of Project.
3. Testing agencies.

B. Water Service: Use water from Owner's existing water system without metering and without payment of use charges.

1. Pay for pumps, pipe, hoses, and backflow preventors as required to distribute water.
C. Electric Power Service: Use electric power from Owner’s existing system without metering and without payment of use charges.

PART 2: PRODUCTS

2.01 MATERIALS

A. General: Provide new materials or undamaged, previously used materials in serviceable condition. Provide materials suitable for use intended.

B. Chain-Link Fencing: Minimum 2-inch, 0.148-inch thick, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch OD line posts and 2-7/8-inch OD corner and pull posts.

C. Portable Chain-Link Fencing: Minimum 2-inch 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch OD line posts and 2-7/8-inch OD corner and pull posts, with 1-5/8-inch OD top and bottom rails. Provide concrete or galvanized steel bases for supporting posts.

D. Lumber and Plywood: Comply with requirements in Division 6 Section "Carpentry."

E. Gypsum Board: Minimum 1/2 inch thick by 48 inches wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C 36.

F. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively.

G. Paint: Comply with requirements in Division 9 Section "Painting."

H. Tarpaulins: Fire-resistant labeled with flame-spread rating of 15 or less.

I. Water: Potable.

J. Wood Walkways: ¾” Plywood, framed with 2x__ joists (size as required to support span), with wood rails to contain occupants.

K. Poly Film Guard: 3 mil. self adhering clear poly film utilizing tack water-based adhesive.

L. Floor Protection (when identified on floor plan or deemed necessary by contractors)

   1. RamBoard, www.ramboard.com, heavy duty (46 mils) temporary floor protection to prevent penetration of spills and allow vapor transmission from below. Seal seams with manufacturer’s recommended seam tape.

2.02 EQUIPMENT

A. General: Provide equipment suitable for use intended.

B. Field Offices: Prefabricated with lockable entrances, insulated, weather-tight; heated and air conditioned. Provide stairs with handrails as required for accessibility.

C. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.

   1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.
D. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

E. Drinking-Water Fixtures: Containerized, tap-dispenser, bottled-water drinking-water units, including paper cup supply.

F. Heating Equipment: Unless Owner authorizes use of permanent heating system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.

2. Heating Units: Listed and labeled, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use for type of fuel being consumed.

3. Hook-up of gas and power, refer to Divisions 23 and 26.

G. Temporary power and lighting, refer to Division 26.

PART 3: EXECUTION

3.01 INSTALLATION, GENERAL

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

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

3.02 TEMPORARY UTILITY INSTALLATION

A. General: Coordinate with appropriate local utility company to install temporary service if required.

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

   a. Pay for utility charges.

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

1. Provide rubber hoses as necessary to serve Project site.

2. Where installations below an outlet might be damaged by spillage or leakage, provide a drip pan of suitable size to minimize water damage. Drain accumulated water promptly from pans.

3. Provide pumps if required due to low static pressure on-site. Equip pumps with surge and storage tanks and automatic controls to supply water uniformly at reasonable pressures.

4. Provide backflow prevention devices to protect Owner’s water system.

B. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.

1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
2. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel as required by government jurisdictions.

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

1. Maintain a minimum temperature of 50 deg F (10 deg C) in permanently enclosed portions of building for normal construction activities, and 65 deg F (18.3 deg C) for finishing activities and areas where finished Work has been installed.

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

E. Telephone/Computer Service:

1. Provide a computer with internet service in each field office.

2. Provide a portable cellular telephone for superintendent's use in making and receiving telephone calls.

3.03 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.

2. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.

3. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate to support loads and to withstand exposure to traffic during construction period. Locate temporary roads and paved areas in same location as permanent roads and paved areas when feasible. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.

2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Division 31 Section "Earthwork."

3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.

4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Division 32 Section "Hot-Mix Asphalt Paving."
C. Traffic Controls: Provide temporary traffic controls at junction of temporary roads with public roads. Include warning signs for public traffic and "STOP" signs for entrance onto public roads. Comply with requirements of authorities having jurisdiction.

D. Dewatering Facilities and Drains: Comply with requirements in applicable Division 33 Sections for temporary drainage and dewatering facilities and operations not directly associated with construction activities included in individual Sections. Where feasible, use same facilities. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining property nor endanger permanent Work or temporary facilities.

2. Before connection and operation of permanent drainage piping system, provide temporary drainage where roofing or similar waterproof deck construction is completed.

3. Remove snow and ice as required to minimize accumulations and provide access to and throughout the site as required to complete the work/fire department access.

E. Project Identification and Temporary Signs: Prepare Project identification and other signs in sizes indicated. Install signs where indicated to inform public and persons seeking entrance to Project. Do not permit installation of unauthorized signs.

1. Prepare temporary signs to provide directional information to construction personnel and visitors.

2. Construct signs of exterior-type Grade B-B high-density concrete form overlay plywood in sizes and thicknesses indicated. Support on posts or framing of preservative-treated wood or steel.

3. Engage an experienced sign painter to apply graphics for Project identification signs. Comply with details indicated.
   a. Paint sign panel and applied graphics with exterior-grade alkyd gloss enamel over exterior primer.

F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Containerize and clearly label hazardous, dangerous, or unsanitary waste materials separately from other waste. Comply with Division 1 Section for progress cleaning requirements.

1. If required by authorities having jurisdiction, provide separate containers, clearly labeled, for each type of waste material to be deposited.

2. Develop a waste management plan for Work performed on Project. Indicate types of waste materials Project will produce and estimate quantities of each type. Provide detailed information for on-site waste storage and separation of recyclable materials. Provide information on destination of each type of waste material and means to be used to dispose of all waste materials.

G. Housekeeping

1. Do not allow debris to accumulate on-site or within the building work areas. The contractor shall implement and provide the following cleaning services:
   a. Debris shall be removed from the construction site and police exterior project site area on a weekly basis at a minimum to clean-up any wind-blown or excess construction materials or debris and dispose of in construction dumpsters to maintain a clean project site.
   b. Debris shall be removed from interior of the buildings on a daily basis and disposed of in construction dumpsters.
c. Lower waste materials in a controlled manner with as few handlings as possible; do not drop or throw materials from heights.

d. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly painted surfaces.

e. Once floor slabs are in place, walk-off mats shall be provided at all exterior entrances that are utilized by the workers. Mats shall be cleaned on a daily basis and change out mats on a monthly basis.

f. Areas without final floor finish in place shall be cleaned of debris and swept on a daily basis.

g. Areas that workers have access to with final floor finish in place shall be vacuumed on a daily basis. Carpeted major circulation paths shall be covered with poly film guard. Replace poly film guard when it develops holes or tears as they occur. Poly film guard to be replaced if left in place over 45 days. Horizontal and vertical surfaces shall be wiped down as construction dust has accumulated.

h. Where Contractor has periodic access to ancillary spaces occupied by Owner, thoroughly clean after each use, so as to not disrupt Owner’s ongoing operations.

i. Failure to maintain a clean construction area may result in the Owner cleaning the site and back-charging the Contractor.

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

H. Common-Use Field Office: Provide an insulated, weather-tight, air-conditioned field office for use as a common facility by all personnel engaged in construction activities; of sufficient size to accommodate required office personnel and meetings of 12 persons at Project site. Keep office clean and orderly.

1. Furnish and equip offices as follows:

   a. Desk and four chairs, file cabinets in quantities to file shop drawings, supplemental instructions, proposal requests, and change orders, a plan table, a plan rack, and bookcase to store project manuals, detail books, and addenda.

   b. Provide a room of not less than 240 sq. ft. for Project meetings. Furnish room with conference table, 12 folding chairs, and 4-foot square markerboard.

I. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility services. Sheds may be open shelters or fully enclosed spaces within building or elsewhere on-site.

J. Lifts and Hoists: Provide facilities for hoisting materials and personnel. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

K. Existing Stair Usage: Use of Owner's existing stairs (as designated by Owner’s representative) will be permitted, as long as stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.

   1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If, despite such protection, stairs become damaged, restore damaged areas so no evidence remains of correction work.

L. Floor Protection: Install temporary floor protection when noted on plans. Seal all seams. Replace during construction if damaged.
3.04 SECURITY AND PROTECTION FACILITIES INSTALLATION

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

B. Stormwater Control: Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of stormwater from heavy rains.

C. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from construction damage. Protect tree root systems from damage, flooding, and erosion.

D. Pest Control: Before deep foundation work has been completed, retain a local exterminator or pest-control company to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests. Engage this pest-control service to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.

E. Site Enclosure Fence: Before construction operations begin, install chain-link enclosure fence with lockable entrance gates. Locate where indicated, or enclose entire Project site or portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs, and other animals from easily entering site except by entrance gates.

1. Drive fence posts in existing soil of gravel and earth.
2. Provide gates in sizes and at locations necessary to accommodate delivery vehicles and other construction operations.
3. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Provide Owner with one set of keys.

F. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

G. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and public of possible hazard. Where appropriate and needed, provide lighting, including flashing red or amber lights.

1. For safety barriers, sidewalk bridges, and similar uses, provide minimum ¾-inch thick exterior plywood and appropriate 2x___ framing for support.

H. Food Consumption: Limit food and soft drink consumption to within the Contractor’s trailer or out of the building.

I. Building Environmental Protection:

1. When operating equipment adjacent to occupied areas of the building:
   a. Coordinate in advance temporary shutdown of building air supply systems.
   b. Close all windows and cover other openings with poly securely taped whenever equipment or vehicle exhaust fumes are present.
   c. Reactivate air supply systems when exhaust emitting activities have been completed.
J. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weather-tight 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.

K. Temporary Dust Control Partitions: Refer to Construction Dust Control Section 01 56 00.

L. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses as required by the local fire marshal.

3.05 OPERATION, TERMINATION, AND REMOVAL

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

B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage caused by freezing temperatures and similar elements.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

2. Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

C. Temporary Facility Changeover: Except for using permanent fire protection as soon as available, do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are the property of Contractor. Owner reserves right to take possession of Project identification signs.

2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.

3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 1 Section "Closeout Procedures."

END OF SECTION 01 50 00
PART 1: GENERAL

1.01 SUMMARY

A. Section Includes:

1. Airborne construction dust/containment control in:
   b. Existing buildings temporarily unoccupied (i.e. summer breaks for schools).
   c. Finished spaces that are unoccupied and construction dust/airborne containments are still being generated (i.e. punchlist completion).

1.02 POLICY

A. Airborne contaminants control is critical in all areas noted in Paragraph 1.02A. Contractor shall limit dissemination of airborne contaminants produced by construction-related activities, including dust, chalk, powders, aerosols, fumes, fibers and other similar materials, in order to provide protection of persons and equipment.

1. Construction activities causing disturbance of existing dust, or creating new dust, or other airborne contaminants, must be conducted in tight enclosures cutting off any flow of particles into occupied areas.

2. Ceilings, walls in Project area must be secure at all times.

1.03 SUBMITTALS

A. Progress Schedules: Submit work areas and procedure schedules for containment of construction dust/airborne contaminants.

B. Work Plan: Drawings and details of extent of enclosures, construction of necessary temporary barriers and exhaust fans, and description of procedures to be used to achieve and maintain control of construction-related airborne contaminants.

1.04 GENERAL ACCESS PROCEDURES

A. Contractor shall notify Architect each time that work requiring access to occupied areas within two weeks of when work is about to begin.

B. Dust Control Preconstruction Meeting: Before any construction on site begins, Contractor and workers are required to attend a mandatory dust control preconstruction orientation session held by Owner’s Representative/Architect for training and instruction on precautions to be taken.

1. Conditions in construction area may be presumed to be in a condition similar to other existing surfaces or a survey of work area to record pre-existing damage may occur at this time.

C. Notification: Contractor shall notify Architect a minimum of 48 hours prior to starting construction activity which might be expected to produce excessive construction dust and airborne contaminants in occupied areas so that additional precautions may be taken.
1.05 TESTING

A. The Owner may provide the following tests and observations:

1. Air Samples: Baseline particle counts and conduct periodic air sampling of Project Areas during construction to monitor effectiveness of containment procedures.

2. Air Pressure: Using visual indicators, the maintenance of negative air pressure in Containment Area relative to Project Areas will be verified on a daily basis.

1.06 DEFINITIONS

A. Containment producing activities include, but are not limited to:

1. Demolition and removal of walls, floors, ceilings, and other finish materials.
2. Demolition of plumbing, mechanical and electrical systems and equipment.
3. Finish operations such as sawcutting, shotblasting/grinding, sanding, painting, and application of special surface coatings.

B. Containment Areas: As determined by Architect and Owner’s Representative and shown within entire construction limits of project area. Includes area of construction, adjacent staging and storage areas, and passage areas for workers, supplies, and waste; includes ceiling spaces above and adjacent to construction, if shown.

C. Project Areas: As determined by Architect and Owner’s Representative and shown within entire construction limits of project area. Includes occupied areas adjacent to Project Area, either occupied or used for passage, as well as areas connected to construction area by mechanical system air intake, exhaust and ductwork.

PART 2: PRODUCTS

2.01 MATERIALS

A. Carpet or Mats: Provide carpets or mats at containment entrances, vacuumed or changed as often as necessary (minimum daily) to prevent accumulation of dust. All vacuuming outside areas not under negative pressure shall be with a certified HEPA-filtered vacuum.

B. Dust Caps: Block off all existing ventilation ducts within the construction area. Method of capping ducts shall be dust tight, withstand airflow and potential damage from construction activities.

C. Portable Enclosures: Whenever work is done outside existing barricaded work areas, provide 4 mil portable polyethylene enclosure capable of sealing off opening fitted tight to ceiling, or provide prefabricated unit.

D. Polyethylene: Polyethylene shall be fire retardant type listed by Fire Underwriter’s Laboratories, Griffolyn #T55R with Griffolyn fire retardant tape, or equal.

E. Exhaust fans: Maintain continuous uninterrupted operation.

PART 3: EXECUTION

3.01 INSPECTION

A. Before any demolition or construction begins, a complete field review of all Project Areas (airborne contaminant control areas) and policies will be conducted and work plan revised if required. Initial work plan shall be presented at dust control preconstruction meeting.
3.02 CONTAINMENT, ENCLOSURES AND BARRIERS

A. Air Quality Contaminant Control: Fasten windows shut, ventilate barricaded construction areas by use of fans to the outside of building.
   1. Maintain a minimum negative pressure of -0.01” WC with door closed at barricade entrance openings and during window replacement by use of fans vented to outside of building.
   2. Secure operable exterior windows and doors/windows not required for construction access as required to maintain negative pressure.
   3. Provide additional local exhaust during welding.

B. Contractor shall install dustproof enclosures for work as submitted on work plan and when required to protect areas occupied by the Owner from dust, debris and damage.
   1. Construction must be conducted in tight enclosures cutting off any flow of dust particles into occupied areas.
   2. The Contractor shall provide additional dustproof enclosures as requested by the Owner when enclosure locations are not adequately containing the dust.
   3. Provide all barricades, warning signs and warning lights to protect the public, the existing building, storage areas and materials or equipment.

C. Enclosure Barricades: Full height, noncombustible construction, with minimum ½ inch gypsum board both sides with 3-1/2 inch R-11 insulation batts to reduce noise. Use 3-inch wide masking tape to tightly seal top, bottom, and all seams to prevent spread of dust to occupied areas, including above ceiling.
   1. Barricade Doors: 3’-0” minimum width (pair of 3’-0” wide doors as required by plans), solid core wood with metal frame and hardware, including closer, tightly weather-stripped to prevent flow of dust. Locate as directed and swing out of construction area (unless directed otherwise by fire marshal). Keep barriers locked outside of working hours. Provide signage at each door “Keep Door Closed.” Three keys for emergency access shall be furnished to the Owner.
   2. Seal all ductwork, piping, conduit, structure and miscellaneous penetrations in enclosure barricades.
   3. Materials for barricade shall be precut in unoccupied areas.

D. Enclosure outside of work area (including spaces above ceilings): Whenever work is necessary outside of the construction barricades the space where work is being done, including ladders, shall be contained within full height enclosure. Contractor may use prefabricated unit.
   1. All work performed outside the construction barricade shown on drawings including all work in corridors and lobbies shall be performed outside of normal working hours and shall be scheduled in advance with Owner except where specified otherwise.
   2. At no time shall any construction equipment or material be stored outside the construction barricade.

E. Furniture and Equipment Protection:
   1. Cover all furniture and equipment remaining in the space with polyethylene. Seal with tape to prevent dust/dirt from reaching the furniture and equipment.
3.03 PROCEDURES

A. General: Contractor shall provide and maintain all barriers, filters, ventilation, walk-off mats and cleaning and removal procedures as detailed in work plan.

1. Traffic between barricaded areas and open areas shall be kept to a minimum. Instruct workers to refrain from tracking dust into adjacent occupied areas or opening windows or doors allowing construction dust/airborne contaminants into adjacent occupied or finished areas. Any dust tracked outside of construction area shall be cleaned up immediately. Contractor shall have the necessary manpower and equipment (HEPA vacuum cleaners, dust and wet mops, brooms, buckets and clean wiping rags) to keep adjacent occupied areas clean at all times. Keep door to such areas closed at all times. Transport materials and refuse into an area from an external site without violating occupied areas by transporting in covered containers.

2. Provide negative pressure in construction area by use of fans to the outside of the building. Block supply and return ventilation as to not recirculate air from construction area to air handlers supplying occupied areas. Rebalance air handling equipment to maintain correct airflow to occupied areas.
   a. Provide adequate forced ventilation of enclosed areas to cure installed materials, to prevent excessive humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases in the building.
   b. Direct exhaust from equipment away from building air intakes and operable windows; assure that filters on building air intakes are operational and protected from excessive amounts of airborne contaminants. Cover intakes of air handling equipment not in operation in proximity to exhaust locations.

B. Sealing of Openings: Use tape or other impenetrable sealant to seal barrier wall seams, cracks around window and door frames, exhaust system ductwork, pipes, floor penetrations, joints and ducts. Seal or filter all open return and exhaust ductwork.

C. Dust Control: The Contractor shall take appropriate steps throughout the term of the Project to prevent airborne dust due to work under this contract. Water shall be applied wherever practical to settle and hold dust to a minimum, particularly during demolition and moving of materials. No chemical palliatives shall be used without permission of the Owner’s Representative.

1. Spray surfaces with water mist during dust-producing interior demolition activities. Hard surface floors in work area, adjacent hallways and passage areas require vacuuming with HEPA-filtered vacuum cleaners and frequent wet-mopping during demolition and construction; protect adjacent carpeted areas with plastic and plywood and vacuum with HEPA-filtered vacuum cleaners.

2. Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent airborne dust from dispersing into atmosphere.

D. Whenever access panels are opened in occupied areas, for work above ceilings, provide portable enclosure ladder and sealing off opening, fitted tight to ceiling.

E. Provide thorough cleaning of existing surfaces which become exposed to dust, before start of Owner’s occupancy.

3.04 FINAL CLEANING

A. Removal of construction barriers shall be done carefully, and when necessary, outside of normal work hours. Remove all tape residue from existing/new surfaces. HEPA vacuum and clean all surfaces free of dust after the removal prior to Owner’s occupancy.

B. Rebalance existing HVAC systems to restore modified systems back to the original design intent.

C. See Specification Section 01 74 00 for additional notes on final cleaning.
3.05 ENFORCEMENT

A. Failure to maintain containment areas will result in issuance of written warning: if situation is not corrected within eight (8) hours of receipt of warning, Owner will have cause to stop the work as provided in Article 2.3 of A201 General Conditions of the Contract for Construction. All costs associated with Owner’s written order to stop the Work and remobilization shall be borne by the Contractor.
END OF SECTION 01 56 00
SECTION 01 73 29
CUTTING AND PATCHING

PART 1: GENERAL

1.01 DESCRIPTION

A. Execute cutting, fitting or patching of Work, required to:
   1. Make several parts fit properly.
   2. Uncover Work to provide for installation of ill-timed Work.
   3. Remove and replace defective Work.
   4. Remove and replace Work not conforming to requirements of Contract Documents.
   5. Install specified Work in existing construction.
   6. Provide finished surfaces (to match adjacent existing surfaces) to fill in voids caused by removal or replacement of materials.

B. Pay for costs caused by ill-timed or defective Work, or Work not conforming to Contract Documents, including costs for additional services of Architect/Engineer.

PART 2: PRODUCTS

2.01 MATERIALS

A. Replacement of Work Removed: Comply with specifications for type of Work to be done.

B. Placement of Work to fill Voids caused by Removal: Comply with latest industry standards for type of Work to be done.

PART 3: EXECUTION

3.01 INSPECTION

A. Inspect existing conditions of Work, including elements subject to movement or damage during:
   1. Cutting and patching.

B. After uncovering Work, inspect conditions affecting installation of new products.

3.02 PREPARATION PRIOR TO CUTTING

A. Provide shoring, bracing and support as required to maintain structural integrity of Project.

B. Provide protection for other portions of Project.

C. Provide protection from elements.
3.03 PERFORMANCE

A. Neatly cut or demolish along straight, true, square lines.

B. Where brick/block is called to be toothed-out, cleanly remove existing masonry units, including associated mortar. Wall to be ready for new installation of whole masonry units, to provide appearance of continuous, uninterrupted brick/block coursing.

C. Execute cutting and demolition by methods which will prevent damage to other Work, and will provide proper surfaces to receive installation of repairs and new Work.

D. Restore Work, which has been cut or removed; install new products to provide complete Work in accordance with requirements of Contract Documents.

E. Refinish entire surfaces as necessary to provide an even finish.
   1. Continuous Surfaces: To nearest intersections.

END OF SECTION 01 73 29
SECTION 01 74 00

FINAL CLEANING

PART 1: NOT USED

PART 2: PRODUCTS

2.01 CLEANING 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.

PART 3: EXECUTION

3.01 FINAL CLEANING

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

B. At completion of construction and just prior to acceptance or occupancy, conduct a final inspection of exposed interior and exterior surfaces.

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

D. Repair, patch and touch up marred surfaces to match adjacent finishes.

E. Broom clean paved surfaces; rake clean other surfaces of grounds.

F. Maintain cleaning until the Building or portion thereof, is occupied by the Owner.
END OF SECTION 01 74 00
PART 1 GENERAL

1.01 SUBSTANTIAL COMPLETION

A. Refer to the General Conditions of the Contract for Construction.

B. When the Project is determined by the Architect to be sufficiently complete to permit utilization for the intended use, the Architect will issue a Certificate of Substantial Completion.

C. To receive the Certificate of Substantial Completion, perform the following:
   1. Submit to the Architect a notice declaring that work is believed to be substantially complete.
   2. Submit a list of work items that remain to be completed or corrected and the date this work will be accomplished.
   3. Obtain Occupancy certificate when required from governing municipality.

D. Architect will visit the project to evaluate the request for issuance of a Certificate of Substantial Completion.
   1. If the Architect concurs that the Project is substantially complete, the Architect will deliver a Certificate of Substantial Completion and a list of work items necessary for completion or correction prior to request for inspection for final completion.
   2. If the Architect determines that the work is not substantially complete, the Architect will deliver to the Contractor a written statement including reasons.
   3. Complete work on the items required by the Architect for achieving substantial completion and make additional written requests for issuance of a Certificate of Substantial Completion until the Architect determines that sufficient Work has been performed.

1.02 FINAL INSPECTION

A. When the Work is considered complete, submit written certification that:
   1. Contract Documents have been reviewed.
   2. Work has been completed and inspected by the Contractor for compliance with Contract Documents and is ready for final inspection.
   3. Building Permit Final has been submitted.

B. Architect will make an inspection to verify the status of completion with reasonable promptness after receipt of such certification.

C. Should Architect consider that the Work is incomplete or defective:
   1. Architect will notify the Contractor in writing, listing the incomplete or defective work.
   2. Take immediate steps to remedy the stated deficiencies, and send a second written certification to Architect that the Work is complete.
3. Architect will reinspect the Work.

D. When the Architect finds that the Work is acceptable under the Contract Documents, he will request preparation of closeout submittals.

1.03 REINSPECTION FEES

A. Should Architect perform reinspections due to failure of the Work to comply with the claims of status of completion made by the Contractor:

1. Owner will compensate Architect for such additional services.

2. Owner will deduct the amount of such compensation from the final payment.

1.04 CLOSEOUT SUBMITTALS TO ARCHITECT

A. When the Architect has determined that the Construction Work is acceptable under the Contract Documents and the Contract fully performed, prepare and submit final Application for Payment to the Architect together with one original and one copy of the following:

1. A letter recommending acceptance of the Project and indicating all punch list items are complete.

2. Contractor's Affidavit of Payment of Debts and Claims, AIA Document G706, with bonds for any exceptions.

3. Consent of Surety to Final Payment on Consent of Surety Company to Final Payment, AIA Document G707.


5. Project Record Documents, if required.

6. Warranties and Bonds.

7. Energy Rebate Applications and specified back-up.

1.05 FINAL ADJUSTMENT OF ACCOUNTS

A. Submit a final statement of accounting to Architect.

B. Statement shall reflect all adjustments to the Contract Sum:

1. The original Contract Sum.

2. Additions and deductions resulting from:
   a. Previous Change Orders
   b. Allowances
   c. Unit Prices
   d. Deductions for uncorrected Work
   e. Penalties and Bonuses
   f. Deductions for liquidated damages
g. Deductions for reinspection payments and costs incurred by Architect or Architect's Consultants if project is not closed out within sixty (60) days of Substantial Completion.

h. Other adjustments

3. Total Contract Sum, as adjusted.

4. Previous payments.

5. Sum remaining due.

C. Architect will prepare a final Change Order, reflecting approved adjustments to the Contract Sums which were not previously made by Change Orders.

1.06 FINAL APPLICATION FOR PAYMENT

A. Submit the final Application for Payment in accordance with procedures and requirements stated in the Conditions of the Contract.
SECTION 01 78 23
OPERATING, MAINTENANCE, AND WARRANTY DATA

1.01 GENERAL
A. Compile product data and related information appropriate for Owner's maintenance and operation of products furnished under the Contract.
B. Prepare operating, maintenance and warranty data as specified in this Section and as referenced in other pertinent section of Project Manual.
C. Instruct Owner's personnel in the maintenance of products and in the operation of equipment and systems.

1.02 QUALITY ASSURANCE
A. Preparation of data shall be done by personnel with the following qualifications:
   1. Trained and experienced in maintenance and operation of the described products.
   2. Completely familiar with requirements of this Section.
   3. Skilled as a technical writer to the extent required to communicate essential data.
   4. Skilled as a draftsman competent to prepare required drawings.

1.03 FORM OF SUBMITTALS
A. Prepare data in the form of an instructional manual for use by the Owner's personnel.
B. Format shall conform to the following:
   1. Size: 8½" x 11".
   2. Paper: 20 pound minimum, white, for typed pages.
   3. Text: Manufacturer's printed data, or neatly typewritten.
   4. Drawings
      a. Provide reinforced punched binder tab, bind in with text.
      b. Fold larger drawings to the size of the text pages.
   5. Provide fly-leaf for each separate product, or each piece of operating equipment.
      a. Provide typed description of product, and major component parts of equipment.
      b. Provide indexed tabs.
   6. Cover: Identify each volume with typed or printed title "OPERATING, MAINTENANCE AND WARRANTY INSTRUCTIONS". List:
      a. Title of Project
      b. Identity of separate structure as applicable.
c. Identity of general subject matter covered in the manual.

C. Binders

1. Commercial quality three-ring binders with durable and cleanable plastic cover.
2. Maximum ring size: 2 inch.
3. When multiple binders are used, correlate the data into related consistent groupings.

D. Digital Format: Submit one PDF copy of the O&M Manual on a DVD Disk.

1.04 CONTENT OF MANUAL

A. Arrange neatly typewritten table of contents for each volume, in the following systematic order.

1. Contractor, name of responsible principal, address and telephone number.
2. A list of each product required to be included, indexed to the content of volume.
3. List, with each product, the name, address and telephone number of:
   a. Contractor or installer.
   b. Maintenance contractor, as appropriate.
   c. Identify the area of responsibility of each.
   d. Local source of supply for parts and replacement.
   e. Include warranty information as specified.
4. Identify each product by product name and other identifying symbols such as set in Contract Documents.

B. Product Data

1. Include only those sheets which are pertinent to the specific product.
2. Annotate each sheet to:
   a. Clearly identify the specific product or part installed.

C. Content, for moisture-protection and weather-exposed products:

1. Manufacturer's data, giving full information on products.
   a. Applicable standards.
   b. Chemical composition.
   c. Details of installation.
2. Instructions for inspection, maintenance and repair.

D. Additional requirements for maintenance data: The respective section of the Project Manual.
1.05 SUBMITTAL SCHEDULE

A. Submit one copy of completed data in final form within thirty days of substantial completion. Copy will be returned with comments.

B. Submit two copies of approved data in final form ten (10) days after comments are received.
END OF SECTION 01 78 23
1.01 GENERAL
A. Fully cooperate with the Architect to accomplish the following.
B. These requirements supplement the requirements set forth in the General Conditions.
C. Maintain at each site one record copy, as applicable, of:
   1. Drawings and Details with addenda marked in.
   2. Specifications with addenda marked in.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Architect/Engineer Supplemental Instructions, Proposal Requests or written instructions.
   6. Approved shop drawings, product data and samples.
   7. Field test records.

1.02 MAINTENANCE OF RECORD DOCUMENTS AND SAMPLES
A. Store record documents and samples in Contractor’s field office in files and racks. Provide locked cabinet or secure storage space for storage of samples.
B. File documents and samples in accordance with the Construction Specifications Institute MASTERFORMAT.
C. Maintain record documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
D. Make record documents and samples available at all times for inspection by Architect or Owner.

1.03 RECORDING
A. Label each document "PROJECT RECORD" in neat large printed letters.
B. Continuously record information and changes.
C. Drawings: Legibly mark to record actual construction.
   1. Depths of various elements of foundation in relation to finish first floor datum.
   2. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Location of internal utilities and appurtenances concealed in the construction, referenced to visible and accessible features of the structure.
   4. Field changes of dimension and detail.
5. Changes made by Field Order or by Change Order.

6. Details not on original contract drawings.

D. Specifications and Addenda - Legibly mark each Section to record:
   1. Manufacturer, trade name, catalog number, and Supplier of each Product and item of equipment actually installed.
   2. Changes made by Field Order or by Change Order.

E. Shop Drawings – Label each set by corresponding specification section. At the completion of the project, provide the Owner with one complete set, reviewed and stamped by architect, organized by specification section in the following formats:
   1. Paper (various sizes) folded to 8 1/2” x 11” and boxed with project name and completion date clearly labeled on exterior.
   2. Scanned PDF copy on a compact disk, ordered by specification section.

1.04 SUBMITTAL

A. Deliver Record Documents to the Owner at contract close-out.

B. Accompany submittal with transmittal letter in duplicate, containing:
   1. Date
   2. Project title
   3. Title and number of each Record Document

END OF SECTION 01 78 39
PART 1: GENERAL

1.01 SUMMARY

A. This Section includes administrative and procedural requirements for instructing Owner’s personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.
3. Recording of training sessions.

1.02 SUBMITTALS

A. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors’ names for each training module. Include learning objective and outline for each training module.

1. At completion of training, submit one complete training manual for Owner’s use.

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.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

E. Demonstration and Training DVD: Submit one copy at end of each training module.

1.03 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 1 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

1.04 COORDINATION

A. Coordinate instruction schedule with Owner’s operations. Adjust schedule as required to minimize disrupting Owner’s operations.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.
PART 2: PRODUCTS

2.01 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
   a. System, subsystem, and equipment descriptions.
   b. Performance and design criteria if Contractor is delegated design responsibility.
   c. Operating standards.
   d. Regulatory requirements.
   e. Equipment function.
   f. Operating characteristics.
   g. Limiting conditions.
   h. Performance curves.

2. Documentation: Review the following items in detail:
   a. Emergency manuals.
   b. Operations manuals.
   c. Maintenance manuals.
   d. Project Record Documents.
   e. Identification systems.
   f. Warranties and bonds.
   g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:
   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.
   h. Normal shutdown instructions.
   i. Operating procedures for emergencies.
   j. Operating procedures for system, subsystem, or equipment failure.
   k. Seasonal and weekend operating instructions.
   l. Required sequences for electric or electronic systems.
   m. Special operating instructions and procedures.
5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.

7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning.
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.

8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

PART 3: EXECUTION

3.01 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.

B. Set up instructional equipment at instruction location.

3.02 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

   1. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

   1. Schedule training through Architect with at least seven days' advance notice.

D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
E. Demonstration and Training Recording: Record each training module separately on digital, window’s compatible DVD media. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.03 REQUIRED DEMONSTRATION AND TRAINING

A. The following is a list of demonstration and training requirements listed in individual specification sections. Inconsistencies or omissions from the list does not relieve the Contractor from providing required demonstration and training delineated in each specification section.

<table>
<thead>
<tr>
<th>Specification Section</th>
<th>Item</th>
<th>Minimum Time*</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 21 13</td>
<td>Solid Plastic Toilet Partitions</td>
<td>As required</td>
</tr>
<tr>
<td>22 11 16</td>
<td>Domestic Water Piping</td>
<td>As required</td>
</tr>
<tr>
<td>23 34 23</td>
<td>HVAC Power Ventilators</td>
<td>As required</td>
</tr>
<tr>
<td>26 05 26</td>
<td>Grounding and Bonding for Electrical Systems</td>
<td>4 hours</td>
</tr>
<tr>
<td>26 09 23</td>
<td>Lighting Control Devices</td>
<td>4 hours</td>
</tr>
<tr>
<td>26 51 00</td>
<td>Interior Lighting</td>
<td>8 hours</td>
</tr>
</tbody>
</table>

* Includes factory start-up.

3.04 DEMONSTRATION

A. Manufacturer’s onsite field technician shall demonstrate the operation of the doors to the Owner. A video outlining the operation of the item or system, scheduled maintenance, basic troubleshooting and care of the item or system shall be provided to the Owner by the door manufacturer. Refer to Section 01 79 00 Demonstration and Training.

END OF SECTION 01 79 00
PART 1: GENERAL

1.01 SUMMARY

A. This Section requires the selective removal of the following:

1. Portions of existing building indicated on drawings and as required, to be removed and disposed of off site, to accommodate new construction.

2. Removal and protection of existing fixtures, materials, and equipment items indicated “salvage.”

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00.

B. Schedule indicating proposed sequence of operations for selective demolition work to Owner's Representative/Construction Manager for review prior to start of work. Include coordination for shutoff, capping, and continuation of utility services as required, together with details for dust and noise control.

1. Provide detailed sequence of demolition and removal work to ensure uninterrupted progress of Owner's on-site operations.

2. Coordinate with Owner's continuing occupation of portions of existing building and with Owner's partial occupancy of completed new construction areas.

C. Photographs of existing conditions of structure surfaces, equipment, and adjacent improvements that might be misconstrued as damage related to removal operations. File with Owner’s Representative/Construction Manager prior to start of work.

D. Product data and Material Safety Data Sheets for any hazardous, highly odoriferous, or high volatile materials to be used, along with procedure and safeguards to be followed during the use of each.

1.03 JOB CONDITIONS

A. Occupancy: Owner will occupy portions of the building immediately adjacent to areas of selective demolition. Conduct selective demolition work in manner that will minimize need for disruption of Owner's normal operations. Provide minimum of 72 hours advance notice to Owner’s Representative of demolition activities that will affect Owner’s normal operations.

B. Condition of Structures: Owner assumes no responsibility for actual condition of items or structures to be demolished.

1. Conditions existing at time of inspection for bidding purposes will be maintained by Owner insofar as practicable. However, minor variations within structure may occur by Owner's removal and salvage operations prior to start of selective demolition work.

C. Partial Demolition and Removal: Items indicated to be removed but of salvageable value to Contractor may be removed from structure as work progresses. Transport salvaged items from site as they are removed.

1. Storage or sale of removed items on site will not be permitted.
D. Protection: Provide temporary barricades and other forms of protection to protect Owner’s personnel, students and general public from injury due to selective demolition work.

1. Coordinate protective measures with those to be performed or constructed for asbestos abatement work. Avoid duplication of work where practical.

2. Provide protective measures as required to provide free and safe passage of Owner’s personnel and general public to occupied portions of building.

3. Erect temporary covered passageways as required by authorities having jurisdiction.

4. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities or work to remain.

5. Protect from damage existing finish work that is to remain in place and which becomes exposed during demolition operations.

6. Protect floors with suitable coverings when necessary.

7. Construct temporary insulated dustproof partitions where required to separate areas where noisy, dirty or dusty operations are performed. Construct partitions out of metal stud, poly and gypsum board and provide dustproof doors and security locks.

8. Provide temporary weather protection during interval between demolition and removal of existing construction on exterior surfaces and installation of new construction to ensure that no water leakage or damage occurs to structure or interior areas of existing building.

E. Damages: Promptly repair damages caused to adjacent facilities by demolition work.

F. Traffic: Conduct selective demolition operations and debris removal to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.

1. Do not close, block, or otherwise obstruct streets, walks, or other occupied or used facilities without written permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

G. Flame Cutting: Do not use cutting torches for removal until work area is cleared of flammable materials. At concealed spaces, flame cutting will not be allowed. Maintain portable fire suppression devices during flame-cutting operations.

H. Utility Services: Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.

1. Do not interrupt utilities serving occupied or used facilities or spaces, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner.

2. Maintain fire protection services during selective demolition operations.

3. Maintain HVAC functions in occupied spaces, in so far as possible. Provide temporary heating and ventilation as required to maintain acceptable working conditions. Do not interrupt functions to occupied spaces, except as shown on the demolition plans or when authorized in writing by the Owner.

I. Environmental Controls: Use temporary enclosures, and other methods to limit dust and dirt migration. Comply with governing regulations pertaining to environmental protection.

1. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution, or damage to finishes or occupied spaces.
J. Do not use highly odoriferous, hazardous or highly volatile chemicals during demolition without the approval of the Owner. Provide appropriate safeguards during the use of such approved materials.

K. Lead Containing Materials: The existing building may contain lead-containing materials, including lead paint. It is the Contractor's responsibility to meet all governmental regulations when dealing with and disposing of lead containing materials.

PART 2: PRODUCTS  (Not Applicable)

PART 3: EXECUTION

3.01 PREPARATION

A. General: Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of areas to be demolished and adjacent facilities to remain.

1. Cease operations and notify Architect immediately if safety of structure appears to be endangered. Take precautions to support structure until determination is made for continuing operations.

2. Cover and protect furniture, equipment, and fixtures from soilage or damage when demolition work is performed in areas where such items have not been removed.

3. Erect and maintain dust-proof partitions and closures as required to prevent spread of dust or fumes to occupied portions of the building.
   a. Where selective demolition occurs immediately adjacent to occupied portions of the building, construct dust-proof partitions of minimum 3-5/8" metal studs, 5/8-inch drywall (joints taped) on occupied side, 1/2-inch fire-retardant plywood on demolition side. Fill partition cavity with insulation. Provide lockable dustproof doors.
   b. Provide similar weatherproof closures for exterior openings resulting from or immediately adjacent to demolition work.

4. Locate, identify, stub off, and disconnect utility services that are not indicated to remain.
   a. Provide bypass connections as necessary to maintain continuity of service to occupied areas of building. Provide minimum of 72 hours advance notice to Owner if shutdown of service is necessary during changeover.

5. Asbestos containing materials shall be removed only by a licensed asbestos abatement contractor. In the event that asbestos containing materials are encountered during the demolition process, implement the following procedures:
   a. If the materials are not disturbed, stop work in the immediate area and notify the Owner/Architect who will arrange for abatement of the material.
   b. If the material has been disturbed by demolition operation, or is otherwise loose or damaged, evacuate the immediate area and restrict access to all personnel. Shut off or isolate HVAC to the area. Notify the Owner/Architect and do not re-enter space until abatement is complete and permission has been received.
   c. Rearrange selective demolition schedule as necessary to continue overall job progress without undue delay.
3.02 DEMOLITION

A. General: Perform selective demolition work in a systematic manner. Use such methods as required to complete work indicated on Drawings in accordance with demolition schedule and governing regulations.

1. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain using power-driven masonry saw or hand tools.
   a. See drawings to identify locations where masonry is to be toothed-out.
   b. Where brick/block is called to be toothed-out, cleanly remove existing masonry units, including associated mortar. Wall to be ready for new installation of whole masonry units, to provide appearance of continuous, uninterrupted brick/block coursing.

2. For interior slabs on grade, use removal methods that will not crack or structurally disturb adjacent slabs or partitions. Use power saw where possible.

3. Completely fill below-grade areas and voids resulting from demolition work. Use compacted backfill as specified in Section 31 00 00.

4. Remove floor or wall tile, where indicated, in a manner such that the surface will be ready for new installation of whole tile units, to provide the appearance of continuous, uninterrupted tile.

5. Provide for effective air and water pollution controls as required by local authorities having jurisdiction.

B. If unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure both nature and extend of the conflict. Submit report to Architect in written, accurate detail. Pending receipt of directive from Architect, rearrange selective demolition schedule as necessary to continue overall job progress without undue delay.

C. Prior to any floor slab cutting and removal, contractor to identify any and all underground mechanical and electrical items by means such as, but not limited to: X-ray, ground penetrating radar, tracing, etc. Any damage will be replaced at expense of Contractor. Contractor must give General Contractor or Construction Manager 48 hour notice prior to any floor slab cutting.

D. If carpet to be removed is glue applied over vinyl asbestos tile. Use power carpet stripper or other device known to remove carpet with minimal damage to or loosening of, underlying tile.

E. Leave all surfaces and work ready and acceptable to the next trade. Use only materials and techniques that are acceptable to subsequent trades to remove materials from surfaces to remain.
   1. Remove adhesive and other materials where wall and floor coverings are removed.
   2. Patch or repair demolition in excess of that shown on drawings.

3.03 SALVAGED MATERIALS

A. Salvaged Items: Where indicated on Drawings as “Salvage”, carefully remove indicated items, clean and store.

1. Furniture/building contents, not scheduled for reuse, remain property of Owner. Notify Architect if such items are encountered and obtain approval regarding method of removal and salvage for the Owner.

2. Store salvaged items to be reused off the ground in a clean, dry location, away from uncured concrete or masonry. Cover with waterproof material in a manner that permits air circulation within covering.

3. For items to be reused, inventory, label with previous location and new location.
3.04 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove from building site debris, rubbish, and other materials resulting from demolition operations. Transport and legally dispose of off site.

   1. If hazardous materials are encountered during demolition operations, comply with applicable regulations, laws, and ordinances concerning removal, handling, and protection against exposure or environmental pollution.

   2. Burning of removed materials is not permitted on project site.

3.05 CLEANUP AND REPAIR

A. General: Upon completion of demolition work, remove tools, equipment, and demolished materials from site. Leave interior areas broom clean.

   1. Repair demolition performed in excess of that required. Return elements of construction and surfaces to remain to condition existing prior to start operations. Repair adjacent construction or surfaces soiled or damaged by selective demolition work.

   2. Remove protection when no longer required by demolition and remodeling work.
SECTION 04 20 00
NON-BEARING UNIT MASONRY

PART 1: GENERAL

1.01 SUMMARY

A. Section includes:

1. Furnish and install interior brick where shown on the drawings.

2. Installation of acoustic spray system at top of walls and penetrations (sealing of mech/elec penetrations specified in Div 21-28) as noted on details.

3. Remove masonry as required to tooth-in new work when toothing-in is indicated on the drawings.

1.02 SUBMITTALS

A. Submit in accordance with Section 01 33 00.

1. Mix Design: Submit mix designs for each mortar type at least seven days prior to preparation of job mortar and delivery to the site. Include copies of test reports for aggregate and mortar strength.

2. Mortar Mixes: Test mortar for consistency, compressive strength and water retentivity in accordance with ASTM C780 recommendations for preconstruction testing.

   a. Preconstruction tests will be used to establish optimum mortar proportion and establish control values for construction testing. They are not required to meet the compressive strength requirements of ASTM C270.

3. Test Reports

   a. Submit reports on manufacturer's normal quality control.

   b. Provide report on modified ASTM C67 test for face brick as follows: Test to determine if the exterior face brick will meet the SW grade requirements of ASTM C216. Testing is recommended to document compressive strength, saturation coefficient, dimensions, distortion and potential for efflorescence. For this testing, a total of 15 bricks will be required. Make the samples representative of the whole lot of brick from which they are selected and include specimens' representative of the complete range of colors and sizes of the brick in the shipment. Upon completion of testing, cut several of the brick samples and observe the cross section for the presence of stratification.

4. Submit samples of all specified masonry accessories for Architect's review.

B. Masonry Samples

1. Manufacturer's samples: Preliminary selection of brick type and color has been based upon manufacturer's samples supplied to the Architect prior to bidding. Brick supplied to the site which, in the judgment of the Architect, varies significantly from these samples in color, color range or finish will be rejected.

1.03 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Handle, transport, and store at the job site in a manner that will avoid damage.
B. Protect masonry units from water. Deliver the units to the job cubed on pallets.

C. Deliver and store scored masonry units with cardboard separators to reduce chipping and other damage to block surface and edges.

D. Store materials under cover in dry place; in manner to prevent damage, intrusion of foreign material. During freezing weather protect all masonry units with tarpaulins or other suitable material. Store concrete masonry under covers that will permit circulation of air, prevent excessive moisture absorption; protect against wetting prior to use.

PART 2: PRODUCTS

2.01 MORTAR MATERIALS

A. Portland Cement: ASTM C150, Type I. Use of masonry cement is not permitted.

B. Hydrated Lime: ASTM C207, Type S.

C. Aggregates: ASTM C144.

D. Water: Clean, potable, free of deleterious amounts of acids, alkalines or organic materials.

E. Pre-Mixed Mortar: ASTM C387. Specific property and material requirements of this Section shall govern.

F. Antifreeze Compounds: Not allowed in mortar to lower freezing point.

2.02 MORTAR MEASURING AND MIXING

A. Measure and mix mortar in accordance with ASTM C270 (Property Specifications) and as follows:

1. Component proportions by mortar type are as follows:

<table>
<thead>
<tr>
<th>Mortar Type</th>
<th>Portland Cement</th>
<th>Hydrated Lime</th>
<th>Aggregate</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>1 part</td>
<td>1/4</td>
<td>See Below</td>
</tr>
<tr>
<td>S</td>
<td>1 part</td>
<td>1/4 to 1/2 part</td>
<td>See Below</td>
</tr>
<tr>
<td>N</td>
<td>1 part</td>
<td>1/2 to 1 1/4 parts</td>
<td>See Below</td>
</tr>
</tbody>
</table>

Volume of aggregate measured in a loose, damp condition shall be not less than 2 ¼ times and not more than 3 times the sum of the volumes of cement and lime used.

2. Accurately maintain and control the proportions of the mortar materials during the entire progress of the work.

3. Mix mortar as required for immediate use only and discard any mixed for a period exceeding 2 ½ hours.

4. Thoroughly mix cementitious materials and aggregates with the amount of water to produce satisfactory workability. Machine mix all mortar.

2.03 MORTAR SOURCE QUALITY CONTROL

A. Test proposed aggregate for conformance to ASTM C144 and these specifications.

B. Test each mortar mix design for water retentivity and compressive strength in accordance with ASTM C270.
C. Mix mortar in the laboratory from representative samples of materials to be used in the Work, including selected colorants. Average compressive strength at 28 days shall be as follows:

<table>
<thead>
<tr>
<th>Mortar Type</th>
<th>Compressive Strength Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>2,500 psi - 3,000 psi</td>
</tr>
<tr>
<td>S</td>
<td>1,800 psi - 2,200 psi</td>
</tr>
<tr>
<td>N</td>
<td>750 psi - 1,100 psi</td>
</tr>
</tbody>
</table>

D. Adjust mix design so as to achieve compatibility with brick to be supplied, considering initial rate of absorption of brick and water retentivity of mortar.

E. Do not start masonry work until Architect has reviewed test reports and accepted mix design.

F. Prepare and test new mix designs if mortar does not meet specifications or if, during the course of the Work, significant changes occur in aggregate or other materials.

G. Use field measuring methods to accurately control mortar mix proportions.

2.04 MASONRY ACCESSORIES

A. Horizontal Wall Reinforcement and Masonry Veneer Anchors: ASTM A153 - Class B2 hot dipped, galvanized, (unless noted otherwise) Hohmann & Barnard or equivalent products by other manufacturers are acceptable.

1. Non-load bearing partitions: "Ladur #220 Ladder-Mesh" type standard weight with No. 9 side and cross rods.

2. Width: Approximately 2 inches less than nominal thickness of wall or wythe.

3. Corners: Furnish pre-fabricated corners and tees except where masonry control and expansion joints indicated. Use for all corners and intersections of masonry walls, including intersections of exterior walls with partitions.


5. Veneer anchors (hot dipped galvanized) for existing back-up (masonry or concrete). HB-5213 Adjustable Veneer Anchor with 3/16” dia. hook and #523 brass expansion bolt. Back plate thickness to accommodate no insulation or match insulation thickness.

B. Reinforcing Steel: New billet stock, deformed bars, ASTM A615 Grade 60, free of mill scale, excessive rust or other coating that would prohibit proper bond with grout or mortar.

C. Brick expansion joint filler or material: HS-NS Closed Cell Neoprene Sponges or equal. Size: thickness to match joint thickness x 3” wide. Constructed of closed cell neoprene.

D. Acoustic spray system: Conform to the requirements of section 07 21 00 Insulation.

2.05 FACE BRICK

A. Brick No.1:

1. Modular
2. Match surface texture of existing brick at corridor, field verify. All new brick to be painted.
2.06 SOURCE QUALITY CONTROL

A. Perform tests of each brick type in accordance with ASTM C67 to determine compliance with ASTM C216, Grade SW. Document compressive strength, saturation coefficient, initial rate of absorption, dimensional tolerance and potential for efflorescence.

B. Perform tests of each brick/mortar combination to determine flexural bond strength in accordance with ASTM C1072.

PART 3: EXECUTION

3.01 LAYOUT

A. Unless noted on Drawings as "clear", all dimensions on Drawings are modular, from center to center of vertical joints and from bottom to bottom of horizontal joints.

B. Lay out exposed masonry to achieve joint pattern shown on Drawings. Where not shown, lay out exposed masonry to minimize cutting of units. Where possible, provide full 8" wide units at outside corners, jambs, and other openings.

3.02 MORTAR

A. Mortar proportioning and mixing as specified.

B. Tempering: The consistency of mortar may be adjusted to the satisfaction of the mason. Use mortar within two and one half (2-1/2) hours after mixing.

C. Type: Lay masonry in mortar of the type specified below, as adjusted for compatibility with masonry units.

<table>
<thead>
<tr>
<th>Kind of Masonry</th>
<th>Mortar Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior walls, non-load bearing at or below grade.</td>
<td>M</td>
</tr>
<tr>
<td>Exterior walls, non-load bearing, above grade; Brick veneer.</td>
<td>S</td>
</tr>
<tr>
<td>Interior non-load bearing partition walls.</td>
<td>N</td>
</tr>
</tbody>
</table>

3.03 PRECAUTIONS

A. Cold Weather Requirements

1. Cold weather conditions exist when temperature is 40 degrees F. or below.

2. Keep masonry units dry. Do not use wet or frozen masonry units.

3. Following general rules may be modified as approved by Architect to suit project conditions.

<table>
<thead>
<tr>
<th>AIR TEMP. (Degrees F.)</th>
<th>CONSTRUCTION REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 - 32</td>
<td>Heat mixing water or sand to produce mortar temperature between 40 degrees F. and 120 degrees F. Heat grout materials when their temperatures are below 32 degrees F. Do not heat water or aggregates used in mortar or grout above 140 degrees F.</td>
</tr>
</tbody>
</table>
32 - 25  Comply with construction requirements above. Heat grout materials so grout is at a
temperature between 70 and 120 degrees F. during mixing and placed at a temperature
above 70 degrees F. Maintain temperature of mortar on boards above 40 degrees F. 
Employ windbreaks when wind is in excess of 15 MPH.

25 - 20  Comply with construction requirements above. Heat masonry units so their temperature
when laid is not less than 20 degrees F. Heat masonry to a minimum of 40 degrees F.
prior to grouting. Utilize sources of heat on both sides of wall under construction.

20 and below  Comply with construction requirements above. Provide enclosure and auxiliary heat to
maintain air temperature above 32 degrees F. for 24 hours. Extend time period to 48
hours for grouted masonry.

MEAN DAILY AIR
TEMP. (Degrees F.) PROTECTION REQUIREMENTS

40 - 32  Protect masonry from rain or snow for 24 hours.
32 - 25  Completely cover masonry for 24 hours.
25 - 20  Completely cover masonry with insulating blankets or approved equal protection for
24 hours. Extend time period to 48 hours for grouted masonry.
20 and below  Maintain masonry temperature above 32 degrees F. for 24 hours by enclosure and
approved supplementary heat. Extend time period to 48 hours for grouted masonry.

B.  Hot Weather Requirements

AIR TEMP  PROTECTION REQUIREMENTS
(Degrees F.)

Greater than 110  Maintain the temperature of mortar and grout below 120°F; flush mixers, mortar
or 90 with 8 mph transport containers and mortar boards with cool water before they come into contact
wind velocity with mortar ingredients or mortar; maintain mortar consistency by re-tempering with
cool water; and use mortar within 2 hours of initial mixing.

C.  Protect facing material against staining; keep top of walls covered with non-staining waterproof coverings when
work is not in progress.

D.  Where fresh masonry joins partially or totally set masonry, clean, roughen, lightly wet set masonry before new
masonry is joined. Make necessary horizontal stop-offs by racking back masonry; do not tooth.

E.  Where units are specified to be wetted, uniformly wet units 3 to 4 hours before using.

3.04 LAYING MASONRY UNITS

A.  Lay masonry plumb, true to lines. Unless noted on drawings as “clear”, all dimensions on drawings are modular,
from center to center of vertical joints and from bottom to bottom of horizontal joints.

B.  Lay hollow masonry units 4 inches or less in thickness, all solid masonry units in full beds of mortar with full head
joints.

C.  Lay hollow masonry units exceeding 4 inches in thickness with divided bed, head joints.
D. Avoid over-plumbing, pounding of corner, jambs after setting masonry in position. Where an adjustment must be made after mortar has started to harden, remove mortar, replace with fresh mortar.

E. Lay masonry within one minute of placing mortar.

3.05 BONDING AND ANCHORAGE

A. Anchor abutting or intersecting non-load bearing walls, partitions at vertical intervals of 2 feet with corrugated ties.

B. Where indicated anchor walls, partitions abutting or facing against steel columns, beams with flexible anchors. Unless indicated otherwise, maximum spacing: 16 inches vertically at columns, 16 inches horizontally at beams.

C. Bond non-bearing walls, partitions of more than one wythe with wire ties; use at least one tie for each 3½ sq. ft. of wall surface; spaced maximum of 16 inches vertically, 36 inches horizontally, stagger alternate rows. Embed ties in horizontal joints.

D. Anchor veneer to backup with ties spaced 16" horizontally and vertically.

3.06 BUILT-IN WORK

A. Consult other trades in advance, make provision for installation of their work in order to avoid cutting, patching. Build-in work specified under other sections as work progresses.

B. Set steel lintels in beds of mortar. Fill door and borrowed light frames solid with grout around jambs, heads of bucks, frames.

3.07 BRICK

A. Clay Masonry Erection, Workmanship: Conform to latest recommended standard specifications for clay masonry as published by the Brick Institute of America (BIA).

B. Moisten brick with absorption rates in excess of 20g/30 sq. in./min. as determined by ASTM C67, so that rate of absorption when laid does not exceed this amount.

C. Finish face joints on interior walls with metal tool to match existing interior brick, field verify.

D. Remainder of Joints: Cut off flush.

E. Lay bricks to match existing bond.

F. Provide continuous vertical 3/8" expansion joints in brick where shown on drawings. Where not shown, or in addition to those shown, provide joints, at a minimum, within two feet of outside corners, at inside corners, above window and door jambs, between dissimilar materials and no more than 20 feet on center elsewhere. Verify location and alignment with Architect.

3.08 POINTING AND CLEANING

A. Point up exposed masonry, fill holes, joints, remove loose mortar, cut out defective joints, repoint with mortar.

B. Thoroughly clean exposed masonry with stiff brushes and water. Before applying any cleaning agent to entire wall, apply to sample wall area or sample panel of approximately 20 sq. ft. in location approved by Architect. Do not proceed with cleaning work until sample area is approved. Use approved cleaning material, method on remaining wall area, including cover of all items that could be damaged (i.e. aluminum, windows, hardware, metal items) prior to using cleaning agents.
C. If stiff brushes, water do not suffice, clean the surface on which no green efflorescence appears with Sure-Klean Vana-Trol as manufactured by Pro So Co., Inc.

D. Remove "problem" stains as follows with the as specified formulations of Pro So Co., Inc., or equal:
   1. Green Efflorescence - "Sure-Klean No. 800 Stain Remover".
   2. Tar, Asphalt - "Sure-Klean Asphalt & Tar Remover".
   3. Ferrous Stains - "Sure-Klean Ferrous Stain Remover".

E. Do not use acid solutions for cleaning masonry units unless specifically approved by Architect.

F. Clean off loose mortar, remove stains from concrete masonry units.

G. Schedule, complete cleaning work as soon as possible; in any event, before Owner's signage work is commenced.
PART 1: GENERAL

1.01 SUMMARY

A. Section includes: All labor, material necessary to complete all items of miscellaneous metal as listed on the schedule in Part 2 and shown on the Drawings.

1. The design, fabrication, transportation to the project site, and associated operations required to complete miscellaneous metals, including all the various metal items manufactured to more or less standard details in sizes conforming to specific requirements of the project.

2. Grating as noted on drawings.

1.02 SUBMITTALS

A. Submit in accordance with Section 01 33 00.

1. Shop drawings required for all items. Show all work to be fabricated with all construction details shown in appropriate scale, methods of attachment to other materials, finished dimensions, shop welds and grinding of welds, field assembly joints, etc. Indicate welded connections, including net weld lengths, using standard AWS welding symbols.

2. Calculations: Accompany shop drawings with a complete structural design and analysis prepared and certified by a Professional Engineer (P.E.) licensed in the State in which the project is located. The design and analysis shall show all design loads, reactions, forces or stresses, and structural characteristics of members and connections for the items listed in section 2.01.B. Include a certified letter stating that shop drawings as submitted conform to the requirements on the design calculations.

3. Coordinate work with other suppliers and subcontractors; obtain their approved shop drawing where necessary, or obtain any necessary additional detail information regarding mounting conditions or other aspects of related work.

1.03 PRODUCT PROTECTION

A. Package, handle, deliver and store at the job site in a manner that will avoid damage or deformation. Damaged material will be rejected.

B. Furnish items to be built into concrete, masonry, carpentry, etc. as the work progresses.

1.04 JOB CONDITIONS

A. Verify dimensions in field, as required, for pre-cut or prefabricated items.

B. Examine job conditions and adjoining construction which may affect the acceptability of the work.
PART 2: PRODUCTS

2.01 DESIGN

A. All materials shall be free from defects impairing strength, durability, appearance, and shall be of the best commercial quality for the purposes indicated. Structural properties shall be such to withstand safely all strains and stresses to which they will be normally subjected.

B. Metal railings, stairs, catwalks, ladders, and other items specified in this section shall be designed to resist self-weight and the more stringent of:
   1. Superimposed Dead and Live Loads indicated on the Contract Documents, and
   2. Loads set forth by the governing Building Code.

C. The maximum Live Load deflection shall be L/360. Deflection determined based on structural section(s) alone.

2.02 MATERIALS

A. Structural Steel: ASTM A36 or A992.

B. Fastenings: Bolts, welds, rivets or other fastenings as required.

C. Anchor Bolts, Nuts: ASTM F1554, Grade 36.

D. Steel Pipe: ASTM A53, Grade B.

E. Steel Tubing: ASTM A500 Grade B.

F. Shop Paint Primer: Manufacturer's standard rust inhibiting primer.

G. Galvanizing: ASTM A123.

H. Expansion and Adhesive Anchors.
   1. Wedge Anchors: Hilti "Kwik Bolt II" or Ramset/Redhead "Trubolt" or equal.
   2. Heavy Duty Sleeve Anchors: Hilti "HSL" or equal.
   3. Adhesive Anchors: Hilti "HVA" or "HIT", Ramset/Redhead "EPCON" or equal.

2.03 GENERAL REQUIREMENTS FOR FABRICATION

A. Weld permanent connections wherever possible; use continuous welds where exposed and grind smooth, straighten members after welding.

B. Perform welding in accordance with AWS D1.1.

C. Perform shop cutting, drilling, fitting and assembly wherever possible. Take field measurements before fabrication when required.

D. Provide all supporting members, fasteners, framing, hangers, bracing, brackets, straps, bolts, angles, etc. required to set, connect the work rigidly and properly to other construction.

E. Install welded end caps at all handrail terminations.
F. At all areas of exposed steel that is to receive a finish:

1. Piece marks hidden: Fabricate such that piece marks are fully hidden in the final structure or made with such media to permit full removal after erection.
2. Mill mark removal: Deliver steel with no mill marks (stenciled, stamped, raised, etc) in exposed locations. Omit mill marks by cutting of mill material to appropriate lengths where possible. Where not possible, fill and/or grind to a surface finish consistent with the adjacent material.

2.04 SHOP COATS PROTECTIVE TREATMENT

A. Clean free of all mill scale, rust and foreign matter by wire brushing, scraping, sandblasting or flame cleaning. Remove grease, oil with solvent. Dust, dirt: Remove with air blast or brush.

B. Apply one shop coat of specified primer to all ferrous metal products, except galvanized. Provide primer for field touch up. Be responsible for quality and adhesion of shop prime finish.

C. Hot-dip galvanize all ferrous metal items exposed to weather in the finish work and shop prime with primer recommended for use on galvanized metal.

2.05 SCHEDULE OF MISCELLANEOUS METAL ITEMS

A. Items listed in this Section are intended only as a guide, but do not relieve responsibility for verifying quantities and inclusion of all similar items. Thoroughly examine all Drawings for items of miscellaneous metal fabrications.

1. Field welded steel angles for support of storefront and masonry walls.
2. Overhead bracing for masonry walls.
3. Other miscellaneous metal items shown on Drawings.

PART 3: EXECUTION

3.01 INSTALLATION GENERAL REQUIREMENTS

A. Anchor to concrete and masonry with expansion or adhesive anchors where built-in anchorage is not provided; do not fasten to wood plugs set in masonry.

B. Vertical members set into concrete or masonry: As shown.

C. Bolts, screws, etc., for field connections: Same material, finish as base material.

3.02 FIELD SPLICES, WELDS

A. Perform field welding in accordance with AWS D1.1.

B. Welders shall be certified by AWS.

C. Continuously weld field splices and grind smooth where exposed to view.

D. Fill exposed splice joints with body filler and sand smooth.

E. Touch-up joints, welds with specified primer.

F. Touch-up damaged hot dipped galvanizing with Galvanizing Repair Compound per manufacturer’s requirements.
3.03 GRATING INSTALLATION

A. Prior to grating installation, contractor shall inspect supports for correct alignment and conditions for proper attachment and support of the gratings. Any inconsistencies between contract drawings and supporting structure deemed detrimental to grating placement shall be reported in writing to the architect or owner’s agent prior to placement.

B. Install grating in accordance with shop drawings and standard installation clearances as recommended by ANSI/NAAMM MBG-531-09 Metal Bar Grating Manual.

C. Protection of Aluminum from Dissimilar Materials:
   1. Where aluminum surfaces come into contact with dissimilar metals, surfaces shall be kept from direct contact by painting the dissimilar metal with one coat of bituminous paint or use of other approved insulating material.
   2. Where aluminum surfaces come into contact with dissimilar materials such as concrete, masonry or lime mortar, exposed aluminum surfaces shall be painted with one coat of bituminous paint or use of other approved insulating material.

D. Use approved attachment system and fasteners to secure grating to supporting members as shown on plans.

3.04 FIELD QUALITY CONTROL

A. Structural Testing and Special Inspection
   1. Comply with the requirements of Section 05 10 00 – Structural Steel Framing
   2. The Owner will employ a Special Inspector for the following:
      a. Visual inspect 100% of all fillet welds, for size, length, and quality, per AWS D1.1. Qualifications: Technical II.

END OF SECTION 05 50 00
PART 1: GENERAL

1.01 SECTION INCLUDES

A. Non-structural dimension lumber framing.
B. Rough opening framing for doors, windows, and roof openings.
C. Roof-mounted curbs.
D. Roofing cant strips.
E. Miscellaneous framing and sheathing.
F. Concealed wood blocking, nailers, and supports.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00:
   1. Product Data: Provide technical data on metal framing connectors, power-driven fasteners, rim boards, and laminated veneer lumber.

1.03 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2: PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. Species as indicated below for each use.
   2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

B. Lumber fabricated from old growth timber is not permitted.

2.02 DIMENSION LUMBER

A. Sizes: Nominal sizes as indicated on drawings, S4S.
B. Moisture Content: S-dry or MC19.
C. Stud Framing (2x4 and 2x6) used in a vertical position in bearing walls:
   1. Grade: No. 2.
D. Joist and Rafter Framing (2x6 through 4x16):
   1. Species: Hem-Fir.
   2. Grade: No. 2.

E. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

2.03 ENGINEERED WOOD PRODUCTS

A. Laminated Veneer Lumber (LVL): APA PRL-501, Stress Class 1.9E-2600F. Parallel Strand Lumber (PSL) with matching or better properties may be substituted.
   1. Acceptable manufacturers include, Weyerhauser, Boise Cascade, Louisiana-Pacific, Georgia-Pacific, Willamette Industries.
   2. Minimum design properties:
      a. Bending = 2600 psi
      b. Horizontal shear perpendicular to glue line = 285 psi
      c. Compression parallel to grain = 2,550 psi
      d. Compression perpendicular to grain parallel to glue line = 700 psi
      e. Modulus of elasticity = 1,900,000 psi
      f. Tension parallel to grain = 1850 psi

B. Laminated Strand Lumber (LSL):
   1. Acceptable manufacturers include: Trus Joist
   2. Minimum design properties:
      a. Bending = 1700 psi
      b. Horizontal shear (plates) = 150 psi
      c. Horizontal shear perpendicular to glue line = 285 psi
      d. Compression parallel to grain = 1,450 psi
      e. Compression perpendicular to grain = 300 psi
      f. Modulus of elasticity = 1,300,000 psi

C. Parallel Strand Lumber (PSL):
   1. Acceptable manufacturers include: Trus Joist
   2. Minimum design properties:
      a. Bending = 2600 psi
      b. Horizontal shear perpendicular to glue line = 285 psi
      c. Compression parallel to grain = 2,550 psi
      d. Compression perpendicular to grain parallel to glue line = 700 psi
      e. Modulus of elasticity = 1,900,000 psi
      f. Tension parallel to grain = 1850 psi

D. Rim Board: APA PRR-401, Rim Board, 1" minimum thickness, or, Rim Board Plus, 1-1/8" minimum thickness.
2.04 CONSTRUCTION PANELS

A. Roof Sheathing: PS-2; APARated Sheathing.
   2. Span Rating: 24/16.
   3. Thickness: 1/2 inch, nominal.
   4. Edges: Square.

2.05 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel per ASTM A 153/A 153M or stainless steel for high humidity and preservative-treated wood locations and to match finish on metal connectors, unfinished steel elsewhere.
   2. Nails: ASTM F1667, common wire nails, unless otherwise specified.
   4. Lag Screws: ANSI/ASME Standard B18.2.1

B. Post-installed anchors: See Division 3.

C. Metal Framing Connectors: Includes hangers, post bases, post caps, tension ties, hold-downs, and framing angles. Hot dipped galvanized steel, sized to suit framing conditions.
   1. Drawings show Simpson Strong-Tie products. Alternate products shall have equal or greater strength.
   2. All products to have current ICC approval.
   3. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing per ASTM A 653/A 653M, hot-dipped galvanizing per ASTM A123, or stainless steel, grade 316L.

2.06 SOURCE QUALITY CONTROL

A. Provide dimension lumber with each piece factory marked with grade stamp of an accredited grading agency identifying grade, species, and moisture content at time of surfacing.

B. Provide APA-rated panels with each piece factory marked with grade stamp of APA identifying type, exposure durability classification, span rating, and thickness.

C. Provide APA-rated rim boards and LVL with APA EWS trademark.
PART 3: EXECUTION

3.01 PREPARATION

A. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION, GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

3.03 FRAMING INSTALLATION

A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.

B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.

C. Install structural members full length without splices unless otherwise specifically detailed.

D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by AFPA Wood Frame Construction Manual and IBC Table 2304.9.1.

E. Strictly comply with manufacturer's installation instructions for product installation. Install all bolts and nails in metal framing connectors.

F. Install horizontal spanning members with crown edge up and not less than 1-1/2 inches of bearing at each end.

G. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.

H. Provide bridging at joists in excess of 8 feet span at mid-span. Fit solid blocking at ends of members.

I. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

3.04 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

C. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

D. Specifically, provide the following non-structural framing and blocking:

1. Cabinets and shelf supports.
2. Wall brackets.
3. Handrails.
4. Grab bars.
5. Towel and bath accessories.
6. Wall-mounted door stops.

3.05 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

B. Provide wood curb at all roof openings except where specifically indicated otherwise. Form corners by alternating lapping side members.

3.06 INSTALLATION OF CONSTRUCTION PANELS

A. General
   1. Install sheathing with panel continuous over two or more spans.
   2. Provide 1/8” space at ends and edges of panels unless otherwise indicated by the panel supplier.
   3. Apply adhesives in strict accordance with manufacturer’s instructions. Apply continuous glue line on joists and a spaced glue line in groove of tongue and groove panels.

B. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
   1. At long edges provide solid edge blocking where joints occur between roof framing members.
   2. Nail panels to framing; staples are not permitted.

3.07 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Surface Flatness of Floor: 1/4 inch in 10 feet maximum, and 1/2 inch in 30 feet maximum.

3.08 CLEANING

A. After erection and attachment of lumber, remove clay, mud, or other foreign materials from all members.

B. Waste Disposal: Comply with the requirements of Section 01 7419.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

C. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.

D. Prevent sawdust and wood shavings from entering the storm drainage system.
END OF SECTION 06 10 00
SECTION 07 21 00
INSULATION

PART 1: GENERAL

1.01 SUMMARY
A. Section includes product specification of the following:
   1. Sound batt insulation used to control sound transfer in stud wall construction.
   2. Expanding foam insulation as shown on drawings.
   3. Vapor barriers used under slab, and in combination with batt insulation in walls.
   4. Acoustic spray system to seal walls to structural deck.

1.02 SUBMITTALS
A. Submit in accordance to Section 01 33 00 Submittals.
B. Vapor Barriers
   1. Manufacturer’s product samples and literature.
   2. Manufacturer’s installation instructions for placement, seaming and pipe boot installation.
   3. Third party laboratory test results showing compliance with specified properties.

1.03 PRODUCT DELIVERY, STORAGE, AND HANDLING
A. Deliver material to the site in unopened packages, with identification labels intact.
B. Store under water-resistant cover and protect from weather and direct sunlight.
C. Remove damaged materials from site.

1.04 ENVIRONMENTAL REQUIREMENTS
A. Do not install rigid insulation (on vertical surfaces with adhesive) when temperature is below 40° F., during rain or wet weather, or when surfaces are wet.

1.05 SCHEDULING
A. Coordinate installation with other trades whose work may be affected or have effect.

PART 2: PRODUCTS

2.01 MATERIALS
A. Sound Batt Insulation: ASTM C665, type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag, wool or rock wool. Fiberglass batts are not considered an equal.
   1. Fire resistance-rated assemblies: Comply with mineral-fiber requirements of assembly.
   2. Use 2” thick batts at stud cavities, 3” thick elsewhere.
B. Acoustic Spray System:

1. Hilti CP 572 Smoke and Acoustic Spray or equal.
   a. Chemical basis: Acrylic
   b. Curving time: +/- 3 days
   c. Skin-forming time: +/- 15 minutes
   d. Application temperature range: 40°F to 104°F
   e. STC classification per ASTM E90: 56
   f. Flame spread per ASTM E84-08: Flame spread: 10 and smoke development: 5
   g. Movement capability: Approximately 12.5%
   h. Mold resistant
   i. Backing material: Mineral wool.

C. Expanding Foam Insulation: Dow Chemical Great Stuff Pro or equal one part polyurethane foam sealant.

1. Conform to ASTM C557-93, D6464, CA25-4 and is UL Class 1 (Flame Spread of 15, Smoke of 20).
2. Application temperature range of 25°F to 120°F.
3. Paintable, stainable and sandable.
5. Minimum R.Value of 4 per inch.

D. Vapor Barriers:

1. Under Floor Slabs: Meet requirements of ASTM E1745 Class A.
   a. Materials: Meets Class A, 15 mil minimum thickness, high density polyethylene constructed of 100% virgin high-grade, polyolefin resins conforming to the following properties.
      1) Water Vapor Permeance ASTM E 96 0.01 perms (US) per ASTM E 1745 Sec. 7.1
      2) Water Vapor Transmission ASTM E 96 0.004 perms (g/hr-m2)
      3) Water Vapor Barrier ASTM E 1745 Exceeds Class A (Plastics)
      4) Tensile Strength ASTM D 882 60 lbs/in.
      5) Puncture Resistance ASTM D 1709 2200 grams
      6) Life Expectancy ASTM E 154 Indefinite
      7) Chemical Resistance ASTM E 154 Unaffected
      8) Peel Adhesion to Concrete ASTM D 903 8 lbs/in.

2. Vapor Barrier Accessories:
   a. Seam tape and vapor proofing mastic conforming to the following properties and as recommended by vapor barrier manufacturer:
      1) Water Vapor Permeance ASTM E 96 0.03 Perms
      2) Tensile Strength (lbs/in) ASTM D 1970 MD-20.09/TD-26.42
      3) Peel Adhesion (lbs/in) ASTM D 3330 5.55
      4) Total Thickness 6 mil
   b. Pipe boots constructed from vapor barrier material, pressure sensitive tape and/or mastic per manufacturer’s instructions.
   c. Mastic to have a water vapor transmission rate per ASTM E 96, 0.3 perms or lower.
   d. Material for conduit/pipe bank sealing (when pipe boots will not work): Granular Seaming Bentonite with the following properties:
      1) Moisture: 9%
2) PH of 6 percent suspension: PH 9.5
3) Plate Water Absorption: 900 w+%
4) Swell Index (ASTM D 5890): 28 ml
5) Specific Gravity: 2.7
6) Calcium Oxide (CaO): 0.70%
7) Surface Area (N₂ absorption): 20 m²/gram
8) Bulk Density (uncompacted): 61 lb/ft³
9) Bulk Density (compacted): 68 lb/ft³

e. Termination Bar: TB-100 termination bar with sealant ledge, .100” thick x 1” wide extruded aluminum with ¼” x 3/8” slotted holes at 8” o.c. as manufactured by Tru-Fast Corp (1-800-443-9602) or equal. Vapor Barrier manufacturers standard plastic termination bar is also acceptable. Fasteners to be stainless steel or galvanized for compatibility with aluminum.

PART 3: EXECUTION

3.01 INSTALLATION

A. Refer to specific specification sections for installation.
SECTION 07 51 15
ROOF PATCHING

PART 1: GENERAL

1.01 SUMMARY
A. Maintain all existing roof warranties; coordinate with Owner for manufacturers. Roofer must be certified by manufacturer to work on warranted roof.
B. Scope of work includes cutting in and patching of vents, curbs, drains and/or any other miscellaneous work identified on Architectural, Mechanical or Electrical plans.
C. Provide either asphalt bitumen or cold tar type built-up roofing system, including insulation. Contractor responsible to determine suitable system to be compatible with existing roofing system.
D. Provide a SBS Modified Bitumen Built-Up Roofing system, including insulation, where/if required.
E. Provide an EPDM roofing system including insulation, where/if required.

1.02 SUBMITTALS
A. Submit in accordance with Section 01 33 00.
   1. Submit roofing contractors letter certifying roof has been inspected and composition of existing roof determined.
   2. Submit roofing manufacturer’s letter certifying roof has been inspected and existing warranty has been maintained.

1.03 QUALITY ASSURANCE
A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle and store materials in accordance with manufacturer's instructions.
B. FM Class I, UL Class A, Class 90 wind uplift.

1.04 WARRANTY
A. Maintain all existing warranties; coordinate with Owner for manufacturers.
PART 2: PRODUCTS

2.01 MATERIALS

A. Asphalt system:
   3. Ply felts: 2 plies of Type 4 asphalt glass fiber felts.
   4. Interply bitumen: Roofing asphalt, ASTM D 312, type as required by slope.
   5. Deck primer at concrete deck.
   7. Insulation: Rigid glass fiber boards with integrally bonded top covering of saturated felt or Kraft paper.
   8. Walkway protection boards (if required): Mineral surfaced bituminous composition boards; Carey-Tread by Celotex Corp. or approved equal.

B. Coal-Tar System; Koppers, Allied Signal or approved equal.
   2. Base ply: 1 ply coated base sheet.
   4. Interply bitumen: Coal Tar Pitch, ASTM D 450-78, type as required by slope.
   5. Deck primer at concrete deck.
   7. Temperature limitations:
      a. Maximum 400°F.
      b. Minimum 300°F.
      c. Recommended 375°F. (350°F max. in kettle storage)
   8. Envelopes as required.

C. SBS Modified System
   1. Insulation (Base and tapered): Polyisocyanurate roof insulation faced with a universal fiber glass reinforced facer as approved by roofing manufacturer to maintain warranty. (ASTM C1289).
   2. Cap Sheet: DynaKap FR fiberglass and polyester reinforced with fire retardant additives. UL Class A.
   3. Ply Felts: Asphalt coated fiberglass felt complying with ASTM-D-2178 Type VI.
   5. Base Flashing: Reinforced Modified Bitumen membrane flashing consisting of a fiberglass scrim, two polyester mats, an elastomeric base material of SBS rubber and asphalt, with a white ceramic granule surface.
   6. Flashing Cement: Modified Bitumen flashing cement as recommended by roofing manufacturer.
   7. Steep Asphalt: ASTM-D-312, Type III or Type IV per manufacturer's requirements.
   8. Reinforced Modified Bitumen membrane flashing consisting of 180 g/m2 nonwoven polyester mat saturated and coated with a blend of SBS rubber and asphalt, with a white ceramic granule surface.
   9. Roof Walk: Dynaflex Composition Flashing material, cut to length and mopped in hot, steep asphalt.

D. EPDM
   1. Insulation (Based and Tapered): Polyisocyanurate insulation faced with a universal fiber glass reinforced facer as approved by roofing manufacturer.
   2. EPDM membrane: 60 mil at fully adhered, 45 mil at ballasted.
   3. Protection board: ½” high density wood fiberboard with non-asphaltic binders.
4. Provide products for use with specified roofing system including, but not limited to taper primer/wash, bonding cement, lap cement, seam tape, peel and stick tape, flashing, lap caulk, sealing mastic, pourable sealer, prefabricated flashing, termination bar, fasteners / anchors, and pipe boots.

PART 3: EXECUTION

3.01 INSTALLATION

A. Inspect substrate and report unsatisfactory conditions in writing. Beginning work means acceptance of substrate. Coordinate installation with other trades, including carpentry, flashing and penetrating work.

B. Comply with NRCA Roofing and Waterproofing Manual and manufacturer's installation instructions.

C. Clean, prime, and prepare substrate.

D. Install insulation in one layer with tightly butted joints and neatly fitted around penetrations.

E. Install walkway protection membrane at locations indicated and where required to provide access to roof mounted equipment.

F. Restore or replace damaged components. Protect work from damage.
END OF SECTION 07 51 15
SECTION 07 92 00
SEALANTS AND CAULKING

PART 1: GENERAL

1.02 SUMMARY

A. Exterior colored sealants:
   1. Joints in masonry, including architectural precast.
   2. Joints around hollow metal.
   3. Miscellaneous joints where “sealant” or “caulk/caulking” is indicated on drawings.
   4. Joints around mechanical, electrical and architectural penetrations of exterior masonry skin.
   5. Installation of sealant on masonry quality control panel for color match and adhesion verification by means of an adhesion test.

B. Interior colored sealants:
   1. NOTE: Sealant on materials to be painted will be installed after painting is completed and shall match paint color. A “sacrificial” backer rod shall be installed prior to painting to protect joints from paint over spray. This backer rod may be pushed into the joint or removed prior to installation of final backer rod and sealant.
   2. Interior joints in masonry.
   3. Interior joints around hollow metal, including joint between hollow metal and hard surface flooring.
   4. Joints in slabs and at edges where painted, exposed or sealed concrete is shown on Drawings.
   5. SEALANT AT RESILIENT FLOORING WALL JOINT WHERE VINYL BASE IS NOT SCHEDULED.
   6. Miscellaneous joints where “sealants” or “caulk/caulking” is indicated on Drawings.

C. Sealant replacement:
   1. Removal of existing sealants and prepping of joints prior to placement of new sealants.

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00.

B. Product Data: Manufacturer’s data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods including joint design, surface preparation, and application instructions.
   4. Submit manufacturer’s test reports indicating test results of adhesion and/or compatibility testing of samples of substrates which either come in contact with or are in close proximity to sealants.

C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer’s full range of available colors or samples of custom color matches for Architect’s acceptance.

D. Schedules, diagrams, or other means of identifying where specific sealants and sealant colors are to be used, throughout areas of new work.

E. Samples of Warranty.

F. Manufactures approval of installer.
1.05 QUALITY ASSURANCE

A. Applicator Qualifications

1. Company specializing in performing work of this section with minimum three years documented experience, minimum three successfully completed projects of similar scope and complexity, and approved by manufacturer.
2. Designate one individual as project foreman who shall be on site at all times during installation.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in manufacturers unopened original packaging. Inspect for damage.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1. Store materials in a clean, dry area indoors in accordance with manufacturer’s instructions.
2. Store sealants within temperature range in accordance with manufacturer’s instructions.
4. Do not use materials after manufacturer’s use-before date.

1.07 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer’s absolute limits.

1. Do not apply sealants to surfaces that are wet, damp, or contain frost.
2. Do not apply sealants when air or surface temperature is below 40 degrees F.
3. Use caution when applying sealants when air or surface temperature is above 120 degrees F.

1.08 WARRANTY

A. Special Installer’s Warranty: Installer’s standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2: PRODUCTS

2.01 EXTERIOR SEALANTS

A. Hybrid Polymer Sealant: Low modulus, non-sag, elastomeric, hybrid sealant, conforming to ASTM C 920, Type S, Grade NS, Class 50. Maximum VOC: 13.6 g/L.

1. Manufacturers/Products:
   a. BASF MasterSeal NP 150.
   b. SIKA, Sikaflex 15LM.
   c. TREMCO, Dymonic FC

2. Colors: Custom colors to match material or finish sealant occurs in.
   a. See Paragraph 1.04 of this section, for submittal requirements.
2.02 INTERIOR SEALANTS

A. Polyurethane Sealant: Multi-component, high-performance polyurethane sealant conforming to ASTM C 920, Type M, Grade NS, Class 25. Maximum VOC: 25 g/L.

1. Manufacturers/product:
   a. Pecora, Dynatrol II
   b. SIKA, SIKAFLEX 2-C
   c. BASF MaterSeal NP2
   d. Tremco, Dymeric 240/240FC

2. Colors: Custom colors to match material or finish sealant occurs in.
   a. See Paragraph 1.04 of this section, for submittal requirements.

2.03 ACCESSORIES

A. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

B. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

C. Joint Backing: Round foam rod compatible with sealant; oversized 25 to 50 percent larger than joint width; recommended by sealant manufacturer to suit application.

D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

E. Masking Tape: Non-staining, non-absorbent tape product compatible with joint sealants and adjacent joint surfaces.

PART 3: EXECUTION

3.01 EXAMINATION

A. Inspect joints for compliance with requirements for joint configuration, installation tolerance, and other conditions affecting joint sealant performance. Correct unsatisfactory conditions before proceeding.

B. Do not install sealants during use of temporary heaters or until vapors from temporary heaters are flushed from building. Do not install sealant when painting operations are in progress.

3.02 PREPARATION

A. Prepare joints in accordance with ASTM C 1193 and manufacturer’s instructions.

B. Clean out joints immediately before installing joint sealants (within 1 to 2 hours of sealant application), in accordance with joint sealant manufacturer's recommendations and the following requirements:

   1. Remove from joint substrates foreign material which could interfere with adhesion of joint sealant, including paints other than permanent protective coating tested and approved for sealant adhesion and compatibility by sealant manufacturer, oil, grease, waterproofing, water repellants, water dirt, and frost.

   2. Clean porous joint substrates using approved methods such as brushing, grinding, blast cleaning, mechanical abrading, and acid washing as appropriate, 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 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 and other nonporous substrates by using chemical cleaners or other means that neither are harmful to substrates nor leave residues capable of interfering with adhesion of joint sealants.

C. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealant manufacturer. Apply primer to comply with joint sealant manufacturer's recommendations. Confine primers to area of joint sealer bond; do not allow spillage or migration onto adjoining surfaces. Allow primer to dry before applying sealant.

D. Masking Tape: Use masking tape where required to prevent contamination of adjacent surfaces; remove tape immediately after tooling and before sealants begin to cure without disturbing seal.

E. Ensure air quality is such that dust and other particles will not adhere and set into sealant surface.

3.03 SEALANT INSTALLATION

A. Comply with joint sealant manufacturer's printed installation instructions.

B. Installation of Sealant Backings:

1. Install joint filler to provide support of sealant during application and at position required to produce the cross-sectional shape and depth of installed sealant relative to joint width that allows optimum sealant movement capability.
   a. Do not leave gaps between ends of joint fillers.
   b. Do not stretch, twist, puncture, or tear joint fillers.
   c. Remove fillers which have become wet prior to sealant application and replace with dry materials.

2. Install bond breaker tape when joint depth is to shallow to allow backer rod.

C. Installation of Sealant:

1. Install sealants by proven techniques that result in direct contact with and full wetting of joint substrates by joint sealant, completely filling recesses provided and providing uniform cross-sectional shapes and depths relative to joint widths. Sealant depth to be ½ the width of the joint and 1/3 the width at the center, creating an hourglass shape. Maximum depth of caulk at center to be 3/8”. Air pockets or voids are not acceptable.

2. Immediately after sealant application and prior to the skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Do not use tooling agents which discolor sealants or adjacent surfaces or which are not approved by sealant manufacturer.

3. Remove excess sealant from surfaces adjacent to joint.

4. Work that includes air pockets, voids, irregular surfaces, dust/debris in surface of sealant, and sealant overlapping adjacent surfaces, among other possible imperfections, will be rejected.

3.04 PROTECTION AND CLEANING

A. Protect joint sealers, during and after curing, from contamination or damage. Cut out and remove damaged or deteriorated sealers and replace with new materials.

B. Clean excess sealants or sealant smears adjacent to joints as work progresses.
3.05 FIELD QUALITY CONTROL

A. Perform adhesion tests on exterior sealant in accordance with manufacturer’s instructions and ASTM C1193, Method A, Field-Applied Sealant Joint Hand-Pull Tab.

1. Perform 5 tests for first 1,000 linear feet of applied exterior sealant and 1 test for each 1,000 feet of seal thereafter. If there is less than 1,000 feet, perform 1 test per floor per building elevation minimum.
2. For sealant applied between dissimilar materials, test both sides of joint.

B. Sealants failing adhesion test shall be removed, substrates cleaned, sealants re-installed, and re-testing performed.

C. Maintain test log and submit report to Architect indicating tests, locations, dates, results, and remedial actions.
END OF SECTION 07 92 00
SECTION 09 21 16

GYPSUM BOARD

PART 1: GENERAL

1.01 SUMMARY

A. Section includes:

1. Non-load bearing interior metal stud framing for drywall.
2. Gypsum wallboard and joint system.
3. Installation of acoustic spray system at top of walls and penetrations (sealing of mech/elec penetrations is specified in Div 21-28) as noted on drawing.
4. Mold and moisture resistant gypsum board at inside face of exterior walls.
5. Sound batt insulation and acoustic sealant at gypsum board.
6. Gypsum tile backer board as a substrate for porcelain or ceramic wall tile.

1.02 SUBMITTALS

A. Submit in accordance with Section 01 33 00.

1. UL listings for gypsum board partitions for proposed products.
2. Samples of mold and moisture resistant gypsum board.
3. Samples of gypsum tile backer board.
4. Samples of abuse-resistant gypsum board.

1.03 QUALITY ASSURANCE


1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery and Handling

1. Deliver materials to the project site with manufacturer's labels intact and legible.
2. Handle materials with care to prevent damage.
3. Deliver fire-rated materials bearing testing agency label and required fire classification numbers.
4. The plastic packaging used to wrap gypsum panel products for shipment is intended to provide temporary protection from moisture exposure during transit only and is not intended to provide protection during storage after delivery. Such plastic packaging shall be removed immediately upon receipt of the shipment.

   a. Failure to remove protective plastic shipping covers can result in condensation which can lead to damage, including mold.
B. Storage

1. Store materials inside under cover, stack flat, properly supported on a level surface, all in same direction, off of floor. Gypsum panel products to be fully protected from weather, direct sunlight exposure and condensation.

2. Avoid overloading floor system

3. Store adhesives in dry area; provide protection against freezing at all times.

4. Steel framing and related accessories shall be stored and handled in accordance with AISI’s “Code of Standard Practice”.

1.05 JOB CONDITIONS

A. Environmental Conditions

1. Do not install gypsum board products at temperatures below 40°F for mechanical installation and 50°F for adhesive installation, unless approved by manufacturer.

2. Measure temperature and humidity on a daily basis during taping operations. Re-application of taping compound shall not occur sooner than shown on the table in Gypsum Association Brochure GA-236.

3. Temperature: During cold weather, in areas receiving wallboard installation, maintain temperature range between 55°F to 90°F for 48 hours before, and during gypsum board and joint treatment application. Maintain specified temperature range until joint treatment is completely dry.

4. Ventilation
   a. Provide ventilation during and following adhesives and joint treatment applications.
   b. Use temporary air circulators in enclosed areas lacking natural ventilation.
   c. Under slow drying conditions, allow additional drying time between coats of joint treatment.
   d. Protect installed materials from drafts during hot, dry weather.

B. Protect adjacent surfaces against damage and stains.

1.06 JOB COORDINATION

A. Coordinate Work with installation of metal framing and electrical work.

B. Coordinate framing and blocking for wall mounted accessories with Section 06 10 53.

PART 2: PRODUCTS

2.01 PANELS, GENERAL

A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

B. General: Complying with ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
2.02 GYPSUM BOARD

A. Standard

1. Panel Physical Characteristics.
   a. Core: Regular
   b. Surface Paper: 100% recycled content paper on front, back and long edges.
   c. Long Edges: Tapered; square edge acceptable at areas with Level 1 finish.
   d. Thickness: As noted on drawings.
   e. Panel shall comply with requirements of ASTM C 1396 Standard Specification for Gypsum Board.

B. Fire-Resistance Rated.

1. Type X, Panel Physical Characteristics
   a. Core: Fire-resistant rated gypsum core.
   b. Surface Paper: 100% recycled content paper on front, back and long edges.
   c. Long Edges: Tapered; square edge acceptable at areas with Level 1 finish.
   d. Thickness: 5/8”
   e. Panel shall comply with Type X requirements of ASTM C 1396 Standard Specification for Gypsum Board.

2. Type C, Panel Physical Characteristics
   a. Core: Fire-resistant rated gypsum core.
   b. Surface Paper: 100% recycled content paper on front, back and long edges.
   c. Long Edges: Tapered; square edge acceptable at areas with Level 1 finish.
   d. Thickness: 1/2”
   e. Panel shall comply with Type C requirements of ASTM C 1396 Standard Specification for Gypsum Board.

C. Mold and Moisture Resistant

1. Panel Physical Characteristics
   a. Core: Moisture resistant (moisture and fire-resistant rated at Type X).
   b. Surface Paper: Coated fiberglass mat on face, back and long edges.
   c. Long Edges: Tapered; square edge acceptable at areas with Level 1 finish.
   d. Thickness: As noted on drawings. (5/8” at fire-resistant applications)
   e. Humidified Deflection: Not more than ¼” when tested in accordance with ASTM C473 and C1658.
   f. Water Absorption: Less than 5% of weight when tested in accordance with C1396M and C1658.
   g. Mold/Mildew Resistance: 10 when tested in accordance with ASTM D 3273
   h. Permeance: Not more than 1.0 perms when tested in accordance with ASTM E96.

D. Gypsum Tile Backer Board:

1. Panel Physical Characteristics
   a. Core: Moisture resistant (moisture and fire-resistant rated at Type X).
   b. Surface Paper: Coated fiberglass mat on face, back and long edges.
   c. Long Edges: Tapered; square edge acceptable at areas with Level 1 finish.
   d. Thickness: As noted on drawings. (5/8” at fire-resistant applications)
   e. Humidified Deflection: Not more than ¼” when tested in accordance with ASTM C473 and C1178.
   f. Water Absorption: Less than 5% of weight when tested in accordance with C1396M and C1178.
   g. Mold/Mildew Resistance: 10 when tested in accordance with ASTM D 3273
   h. Permeance: Not more than 1.0 perms when tested in accordance with ASTM E96.
E. Abuse-Resistant

1. Panel Physical Characteristics
   a. Core: Fire resistance rated gypsum core, with additives to enhance, surface indentation resistance and impact resistance.
   b. Surface Paper: 95% recycled content moisture/mold/mildew resistance paper on front, back and long edge.
   c. Long Edges: Tapered; square edge acceptable at areas with Level 1 finish.
   d. Thickness: 5/8"
   e. Panel shall comply with the following requirements:
      1) Type X: ASTM C 1629.
      2) Surface Abrasion Resistance, Level 3.
      3) Indentation Resistance, Level 1
   f. Mold/Mildew Resistance: 10 when tested in accordance with ASTM D3273.

F. Metal Framing:

1. Protective Coating: ASTM C 645/C, 645M G40 (Z120) or equivalent corrosion resistance.
   a. Metal studs and runners.
      1) Metal Thickness
         a) 20 gauge or ProSTUD 20 gauge equivalent.
         b) 25 gauge or ProSTUD 25 gauge equivalent.
      2) Size: 1 5/8”, 2 ½”, 3 5/8”, 4” or 6” deep as noted on drawings.
   b. 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.
   c. Fire Stop Track: Top runner designed to allow partition head to move while maintaining integrity of assembly fire-resistance rating. Thickness not less than indicated for studs, and of width to accommodate depth of studs.
   d. Hat-Shaped, Rigid Furring Channels
      1) Base Metal Thickness: 0.0179 inch.
      2) Depth: 7/8” or 1 ½” as noted on drawings.
   e. Resilient Furring Channels: ½” deep, steel members designed to reduce sound transmission.
   f. Z-Shaped Furring: With slotted or non-slotted web, face flange of 1 ¼”, wall attachment flange of 7/8”, minimum bare metal thickness of 0.0179 inch and depth required to fit insulation thickness.
   g. Radius Framing: Steel sheet runner for non-structural curves, bends, variable radii and arches. Design to provide higher strength capacity than conventional lighter gauge material by using a work-hardened steel base strip.
      1) Base Metal Thickness and Size: Match studs.
   h. Flat Strap and Backing Plate Sheet: For blocking or bracing.
      1) Base Metal Thickness: 20 gauge.
      2) Width: 6 inch.
i. Fasteners for Metal Framing: Provide fasteners of type, material, size, corrosion resistance, holding power and other properties required to fasten steel framing and furring member securely to substrates involved; comply with recommendations of gypsum board manufacturers for application indicated.

j. Ceiling Suspension Systems. Use one of the following systems:
   1) Metal studs with depth required to handle span.
   2) 1 ½” cold rolled steel channels, 8 gauge annealed hanger wire and furring channels.
   3) Direct-hung system composed of 8 gauge hanger wire, main beams and interlocking cross furring members as manufactured by:
      b) Chicago Metallic Corp. “Drywall Furring 640/Drywall Furring 660”.
      c) USG Interiors, Inc. “Drywall Suspension Systems”.

G. Accessories:

   a. Material: Galvanized or aluminum-coated steel sheet, rolled zinc.
   b. Shapes:
      1) Cornerbead.
      2) L-C Bead: J-shaped; exposed long flange receives joint compound.
      3) L-Bead: L-shaped: exposed long flange receives joint compound.
      4) Off-angle or splayed cornerbead.
      5) V-shaped Control Joint protected with plastic tape.


3. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
   a. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
   b. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

4. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
   a. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR, 59, Subpart D (EPA Method 24).

5. Sound Batt Insulation and Rigid Wall Insulation: Conform to requirements of Section 07 21 00.

6. Joint Treatment Materials:
   a. General: Comply with ASTM C 475/C 475M.
   b. Joint Tape:
      1) Interior Gypsum Wallboard: 2 1/16” wide paper reinforcing tape.
      2) Glass-Mat Gypsum Wallboard: 2” wide self adhering fiberglass tape.
      3) Tile Backing Panels: As recommended by panel manufacturer.
   c. Joint Compound for Interior Gypsum Wallboard: Drying type pre-mixed vinyl base compound and/or drying type pre-mixed vinyl base topping compound.
   d. Joint compound for glass-mat gypsum wallboard: As recommended by wallboard manufacturer.

7. Acoustic spray system: Conform to the requirements of Section 07 21 00 Insulation.
PART 3: EXECUTION

3.01 EXAMINATION

A. Examine substrates to which gypsum board construction attaches or abuts, installed hollow metal frames, cast-in anchors and structural framing with installer present for compliance with requirements for installation tolerances and other conditions affecting performance of gypsum board assemblies specified in this section.

1. Do not proceed with installation until satisfactory conditions have been corrected.

3.02 INSTALLATION OF STEEL FRAMING, GENERAL

A. Steel framing installation standard: Comply with ASTM C 754.

B. Metal Stud Schedule

1. Use 25 gauge metal studs or equivalent on partitions up to 12’-0” high and soffits.
2. Use 20 gauge or equivalent metal studs on:
   a. Metal stud partitions over 12’-0” high.
   b. Metal stud ceilings.
   c. Double studs at each door and borrowed light jamb and head.
   d. For partitions of any height covered with abuse resistant gypsum board.

C. Install supplementary framing, blocking and bracing at terminations in work and for support of fixtures, equipment services, heavy trim, grab bars, toilet accessories, door bumpers, furnishings and similar construction to comply with details indicated and with recommendations of gypsum board manufacturer.

D. Isolate steel framing from building structure to prevent transfer of loading imposed by structural movement, at location indicated below to comply with details shown on drawings.

1. Where suspended ceiling assemblies abut building structure horizontally at ceiling perimeters or penetrations of ceiling.

2. Where partitions and wall framing abut overhead structure.
   a. Provide slip or cushioned type joints to attain lateral support and avoid axial loading.

E. Do not bridge building expansion and control joints with steel framing or furring members, independently frame both sides of joints with framing or furring members or as indicated.

3.03 INSTALLATION OF STEEL FRAMING FOR CEILINGS AND SOFFITS

A. Suspend ceiling hangers from building structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum not part of supporting structural or ceiling suspension system.
   a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter splaying or other equally effective means.

2. Where widths of ducts and other construction within ceiling plenum produce hanger spacing that interfere with the location of hangers at spacing required to support standard suspension system members, install supplemental suspension system members and hangers in form of trapezes or equivalent devices.
   a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
3. Secure wire hangers to structure, by looping or wire tying, directly to supporting structure, including intermediate framing members. Attach to inserts, eye screws, or other devices appropriate for structure to which hangers are attached as well as for type of hanger involved in manner that will not cause deterioration or failure, due to age, corrosion or elevated temperatures.

4. Do not attach hangers to metal roof deck or metal deck tabs.

5. Do not connect or suspend steel framing from ducts, pipes or conduits.

B. Keep hangers and braces 2 inches clear of ducts, pipes and conduits.

C. Wire-tie or clip furring members to main runners and to other structural supports.

D. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension system abuts vertical surfaces. Mechanically join main beam and cross furring members to each other and butt cut to fit wall track.

3.04 INSTALLATION OF STEEL FRAMING FOR WALLS AND PARTITIONS

A. Install runners (tracks) at floors, ceilings and structural walls and columns where gypsum board stud system abuts other construction.

1. Use proprietary tracks for non-rated and fire rated walls and partitions.
2. Install studs full height for all partitions unless noted otherwise.
3. Where studs are installed directly against masonry or concrete walls, set studs in acoustical sealant.

B. Installation Tolerances: Install each steel framing and furring member so that fastening surface does not vary more than 1/8" from plane of 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 or just above suspended ceilings. 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 ½ inch short of full height to provide perimeter relief.
2. For STC-rated or fire-resistance rated partitions that extend full height, install framing around structural members, as required to support gypsum board closures needed to make partitions continuous from floor to underside of structure above.
3. Install bridging/spacing bar.

D. Brace partition framing, not extending full height to structure above, with studs same size and thickness as partition framing. Provide bracing at:

1. 6'-0" o.c. intervals along length of partitions.
2. Not less than 6'-0" from partition ends and corners.
3. Door and window openings.

E. Terminate partition framing at suspended ceiling where indicated.

F. Install metal studs and furring in sizes and at spacings indicated.

1. Single and Multi Layer Construction: Space studs 16 inches o.c., unless otherwise indicated.

G. Install metal studs with flanges in same direction and leading edge or end of gypsum board panel can be attached to open (unsupported) edges of stud flanges first.
H. Frame door openings to comply with details indicated, with GA-219 and with applicable published recommendations of gypsum board manufacturer. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

I. Frame openings other than door openings to comply with details indicated, or if none indicated, in same manner as required for door openings; and install framing below sills of openings to match framing required above door heads.

1. Extend vertical jamb studs through suspended ceilings and attach to underside of floor or roof structure above.

J. Install rigid wall insulation vertically and hold in place with Z-furring members spaced at 24 inches.

1. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails or screws designed for masonry attachment, spaced at 24 inches o.c.
2. At exterior corners attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw attach short flange of furring channel to web of attached channel. Start from this furring channel with standard width insulation and continue in regular manner.
3. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

3.05 APPLICATION OF GYPSUM BOARD

A. Install the following gypsum board types as follows:

1. Regular type: All non-rated areas unless noted differently below.
2. Type X or C: As required to meet fire-resistant rated assemblies.
3. Mold and Moisture Resistant: All gypsum board on the interior face of an insulated stud exterior wall. (Note: Gypsum Board on furred masonry walls can be regular type.)
4. Gypsum tile backer board: As a substrate for walls covered with porcelain or ceramic tile.
5. Abuse-resistant and high impact resistant: As noted on drawings and/or wall types.

B. Gypsum Board Application and Finishing Standards: Comply with ASTM C 480 and GA-216.

C. Install sound attenuation insulation blankets where indicated, prior to gypsum board, unless readily installed after board has been installed on one side.

D. Single-Layer Application: Install gypsum wallboard as follows:

1. Locate exposed end-butt joints as far from center of walls and ceilings as possible, and stagger not less than 24 inches in alternate courses of board.
2. On partitions/walls apply gypsum board vertically (parallel to framing), unless otherwise indicated or required by fire resistance rated assembly, and provide sheet lengths which will minimize end joints.
   a. On partitions/walls 8’-1” or less in height, apply gypsum board horizontally (perpendicular to framing); use maximum length sheets possible to minimize end joints.
   b. At stairwells and other high walls, install gypsum board horizontal, unless otherwise indicated or required for fire resistance rating.
   c. On Z-furring, apply gypsum panels vertically (parallel to framing). Locate edge joints over furring member.

E. Double-Layer Application: Install gypsum backing board for base layer and exposed gypsum board for face layer.

1. On ceilings apply base layer prior to application of base layer on walls/partitions; apply face layer in same sequence. Offset joints between layers minimum one stud space. Apply base layers at right angles to supports, unless otherwise indicated.
2. On partitions/walls apply base layer and face layer vertically (parallel to framing) with joints of base layer over supports and face layer joints offset minimum one stud space with base layer joints.
F. Install exposed gypsum board with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for light at edges and ends with not more than 1/16 inch open space between boards. Do not force into place.

G. Locate both edge or end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints.

1. Position boards so like edges abut, tapered edges against tapered edges and mill-cut or field-cut ends against mill-cut or field-cut ends.
2. Do not place tapered edges against cut edges or ends.
3. Gypsum panel product joints shall be located so that no joint will align with the edge of an opening unless control joints are to be installed at these locations.
4. Joints on opposite sides of a partition shall not occur on the same stud.
5. In single layer gypsum panel products systems, end joints parallel to and on the same side of framing members shall be staggered between alternate courses of gypsum panel products and from joints on the opposite side of the framing members.
6. In multi-layer gypsum panel product systems, end joints parallel to and on the same side of framing members shall be staggered between alternate courses of gypsum panel products.
7. Base layer end joints parallel to and on one side of framing shall be staggered from base layer end joints on the opposite side of the framing members.
8. Install ceiling boards across framing in manner to minimize end-butt joints, and avoid end joints in central area of each ceiling. Stagger end joints at least 24 inches.

H. Spot grout hollow metal door frames for solid core wood doors, hollow metal doors and doors over 32 inches wide except where full grout is shown. Apply spot grout at each jamb anchor clip just before inserting board into frame.

I. Form control joints and expansion joints at locations indicated or as recommended, with space between edges of boards, prepared to receive trim accessories.

1. Where a control joints occurs in an acoustical or fire-rated system, blocking shall be provide behind the control joint by using a backing material such as 5/8” type X gypsum panel product, or other tested equivalent.

J. Cover both faces of metal stud partition framing with gypsum board in concealed spaces (above ceiling, etc.), except in chase walls which are braced internally.

1. Except where concealed application is indicated or required for sound, fire, air or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq.ft. area, and may be limited to not less than 75 percent of full coverage.
2. Fit gypsum board around ducts, pipes and conduits.

K. Isolate perimeters of non-load-bearing drywall partitions at structural abutments. Provide ¼ to ½ inch space to accept trim edge.

L. Where STC-rated gypsum board assemblies are indicated or drawings indicate acoustical sealant, seal construction at perimeters, behind control and expansion joints, openings, and other penetrations with a continuous bead of acoustical sealant. Include a bead of sealant at both faces of partitions.

1. Comply with ASTM C 919 and manufacturer’s recommendations for location of edge trim and closing off sound flanking paths around or through gypsum board assemblies, including partitions extending above ceilings.
2. Where resilient furring channels are used over steel framing, the screws used to attach the gypsum panel product to the furring channels shall not contact the framing.

M. Gypsum panel products applied to walls shall be applied with the bottom edge spaced a minimum of 1/8 inch and maximum of ¼ inch above the floor.
N. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer’s written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

O. Wall Tile Substrates: For substrates scheduled to receive ceramic or porcelain tile, comply with the following:

1. Install gypsum tile backer board panels to comply with manufacturer’s installation instructions at locations scheduled to receive wall tile. Install with ¼” open space where panels abut other construction.

3.06 METHODS OF GYPSUM BOARD FASTENING

A. Fastener lengths shall be at least 1 1/8” long for ½” gypsum panels and 1 ¼” long for 5/8” gypsum panels used for metal framing.

B. Screws shall be spaced not more than 12 in. o.c. for ceilings and 16 in. o.c. for walls where the framing members are 16 in. o.c. Screws shall be spaced not more than 12 in. o.c. for both ceilings and walls where framing members are 24 in. o.c.

C. Fasteners at gypsum panel product edges or ends shall be located not less than 3/8” from the edge or end. Fasteners at edges or ends in a perpendicular application shall be located not more than 1 in. from the edge or end. Perimeter attachment into partition top and bottom plates is neither required nor recommended except where fire ratings, structural performance requirements, or other special conditions require such attachment.

D. While diving fasteners, gypsum panel products shall be held in firm contact with framing members or underlaying support. Application of fasteners shall proceed from the center or field of the gypsum panel product toward the ends and edges, or shall begin along one edge and proceed toward the other edge.

E. To provide a more flat surface at joints, attach gypsum board to steel studs so leading edge or end of each board is attached to open (unsupported) edge of stud flanges first.

F. Attach gypsum board to supplementary framing and blocking provided for additional support at openings and cutouts.

G. Screws shall be driven so that screw heads are slightly below the gypsum panel product surface without breaking the face paper, fracturing the core, or stripping the framing member around the screw shank.

H. Double-Layer Fastening Methods: Apply base layer of gypsum board and face layer to base layer as follows:

1. Fasten base layer with screws and face layer with adhesive and supplementary fasteners, except where otherwise required for fire-resistance rated assemblies.

3.07 INSTALLATION OF DRYWALL TRIM ACCESSORIES

A. General: Where feasible, use same fasteners to anchor trim accessory flanges as required to fasten gypsum board to supports. Otherwise, fasten flanges to comply with manufacturer’s recommendations.

B. Install corner beads at external corners.

C. Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed. Provide type with face flange to receive joint compound except where “U” bead (semi-finishing type) is indicated.

1. Install “J” bead where drywall construction is tightly butted to other construction and back flange can be attached to framing or supporting substrate.

2. Install “L” bead where edge trim can only be installed after gypsum board is installed.
D. Install control joints at locations as follows:

1. At ceilings, 50'-0" o.c. each way maximum and/or where shown on drawings. At corners and at tee intersections of soffits that change directions.
2. At walls, 30'-0" o.c. maximum, and/or where shown on drawings.
3. Full height door frames shall be considered equivalent to a control joint.

3.08 FINISHING OF GYPSUM WALL BOARD

A. General: Apply joint treatment at gypsum board joints (both directions); flanges of corner bead, edge trim and control joints; penetrations; fastener heads, surface defects and elsewhere as required to prepare work for decoration.

B. Prefill open joints using setting-type joint compound.

C. Apply joint tape at joints between gypsum boards, except where trim accessories are indicated.

D. Glass-Mat Water Resistant Backer Board: Comply with glass mat backer board manufacturer’s recommendations.

E. Water or additive shall not be added to joint compound unless recommended by manufacturer. See quality assurance for application temperature and drying times.

F. Levels of Gypsum Board Finishing per Gypsum Association GA-214 and as note herein:

1. Level 1/Fire Taping: All joints and interior angles shall have tape set in joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable. Tape and fasteners need not be covered.
   a. For use in plenum areas above ceilings, gypsum board not scheduled for paint or wallcovering, gypsum board concealed from view in the finished work, except as noted in level 2.

2. Level 2: All joints and interior angles shall have tape embedded in joint compound and wiped with a joint knife leaving a thin coating of joint compound over all joints and interior angles. Fastener heads and accessories shall be covered with a coat of joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable. Joint compound applied over the body of the tape at the time of tape embedment shall be considered a separate coat of joint compound and shall satisfy the conditions of this level.
   a. For use on areas that are a substrate for tile or wood paneling.

3. Level 3: All joints and interior angles shall have tape embedded in joint compound and one additional coat of joint compound applied over all joints and interior angles. Fastener heads and accessories shall be covered with two separate coats of joint compound. All joint compound shall be smooth and free of tool marks and ridges.
   a. For use on surfaces of mechanical and electrical spaces scheduled to receive paint.

4. Level 4: All joints and interior angles shall have tape embedded in joint compound and two separate coats of joint compound applied over all flat joints and one separate coat of joint compound applied over interior angles. Fastener heads and accessories shall be covered with three separate coats of joint compound. All joint compound shall be smooth and free of tool marks and ridges. When necessary, sand between coats and following final coat to provide smooth surface ready for decoration.
   a. For use on all walls scheduled for paint or wallcovering except those areas noted under Level 3 and 5.
5. Level 5: All joints and interior angles shall have tape embedded in joint compound and two separate coats for joint compound applied over all flat joints and one separate coat of joint compound applied over interior angles. Fastener heads and accessories shall be covered with three separate coats of joint compound. A thin skim coat of joint compound trowel applied, or a material manufactured especially for this purpose and applied in accordance with manufacturer’s recommendations, shall be applied to the entire surface. The surface shall be smooth and free of tool marks and ridges. When necessary, sand between coats and following final coat to provide smooth surface ready for decoration.

a. For use on all ceilings; walls and/or soffits under skylights and clerestories, and as noted on drawings. Note: when Level 5 finish is used, it shall extend to nearest inside or outside corner.

3.09 FINISHING ADJUSTMENT

A. Screw Pop

1. Repair nail pop by driving new screw approximately 1-1/2 inches away and reseat screw.

2. When face paper is punctured drive new screw approximately 1-1/2 inches from defective fastening and remove defective fastening.

3. Fill damaged surface with compound in coats specified by required finish level.

B. Ridging

1. Sand ridges to reinforcing tape without cutting through tape.

2. Fill concave areas on both sides of ridge with topping compound.

3. After fill is dry, blend in topping compound over repaired area.

C. Fill cracks with compound and finish smooth and flush.

D. Application of acoustic spray system

1. Install mineral wood backing at depth required per manufacturer’s details.

2. Apply acoustic spray to required thickness and overlap onto adjacent surfaces as recommended by manufacturer to achieve specified sound transmission classification.

3.10 CLEANING AND PROTECTION

A. Promptly remove any residual joint compound from adjacent surfaces.

B. Protect installed products from damage from weather, condensation, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 21 16
SECTION 09 30 00

TILE

PART 1: GENERAL

1.01 SUMMARY

A. Section includes:

1. Mortar bed installations in toilets, showers, kitchens and other areas shown on drawings with floor drains over depressed substrates.

2. Removal of concrete curing compound on tile installations installed directly over concrete substrates.

3. Ceramic tile on walls.

4. Porcelain tile on floors.

5. Caulking of joints in tile on inside corners of tiled rooms and sealing of joints in tile.

1.02 SUBMITTALS

A. Submit in accordance to Section 01 33 00:

1. Submit two (2) samples each for each different tile piece required for this project.

2. Furnish Master Grade Certificates to Architect for all tile, indicating compliance with TCA 137.1-76.

3. Submit product information on grout and samples indicating color range anticipated, texture.

4. Submit samples of sealant that match grout color.

5. Submit installation system manufacturer qualifications, installer qualifications, and laboratory confirmation of installation materials as outlined in Quality Assurance.

1.03 QUALITY ASSURANCE

A. Installation System Manufacturer (single source responsibility): Company specializing in adhesives, mortars, grouts and other installation materials with ten (10) years minimum experience and ISO 9001 certification. Obtain installation materials from single source manufacturer to insure consistent quality and full compatibility.

B. Submit laboratory confirmation of adhesives, mortars, grouts and other installation materials:

1. Identify proper usage of specified materials using positive analytical method.

2. Identify compatibility of specified materials using positive analytical method.

3. Identify proper color matching of specified materials using a positive analytical method.

C. Installer qualifications: company specializing in installation of ceramic tile, mosaics, pavers, trim units and thresholds with five (5) years documented experience with installations of similar scope, materials and design.

D. The latest edition of following specifications and standards are incorporated by reference:


1.04 FLOOR FLATNESS

A. For new concrete slabs on grade and elevated structural slabs/topping as specified in Section 03 30 00 floor flatness is specified per ACI 117 as follows:

1. F (F) Flat tolerance with an overall value of 35 and a minimum localized value of 21.
2. F (L) Flat tolerance with an overall value of 25 and a minimum localized value of 15.
3. Measured by a manual straightedge method a “flat” floor surface classification, maximum gap for 90% compliance, samples not to exceed ¼” and for 100% compliance, samples not to exceed 3/8”.

B. The flooring contractor will be responsible to provide the necessary means (i.e., grinding/leveling) for additional leveling as required by the flooring manufacturer.

1.05 MOCK-UPS

A. Provide mock-up of each type/style/finish/size/color of ceramic tile, mosaics, pavers, trim unit and threshold, along with respective installation adhesives, mortars, grouts and other installation materials. Mock may be part of final installation if accepted.

1.06 PRE-INSTALLATION CONFERENCE

A. Pre-installation conference: at least three weeks prior to commencing the work attend a meeting at the jobsite to discuss conformance with requirements of specification and job site conditions. Representatives of Owner, Architect, General Contractor or Construction Manager, Tile Subcontractor, Tile Manufacturer, Installation System Manufacturer and any other parties who are involved in the scope of this installation must attend the meeting.

1.07 WARRANTY

A. The manufacturer of adhesives, mortars, grouts, and other installation materials shall provide a written twenty-five (25) year warranty, which covers materials and labor; reference Manufacturer Warranty Data Sheet for complete details and requirements.

B. For exterior facades over steel or wood framing, the manufacturer of adhesives, mortars, grouts and other installation materials shall provide a written ten (10) year warranty, which covers replacement of Manufacturer products only – reference Warranty Data Sheet for complete details and requirements.

1.08 PRODUCT HANDLING, DELIVERY, AND STORAGE

A. Package, handle, deliver and store at the job site in original unbroken containers in a manner that will avoid damage or contamination. All containers shall bear grade seals, manufacturer's name, size, color and quantity.

B. Reject any tiles that are cracked or broken.

1.09 JOB CONDITIONS

A. Set and grout tile when ambient temperature is at least 50°F and rising.
PART 2: PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Manufacturers listed in this specification are approved under the following conditions:

1. A manufacturer listed in both the specification and the Material Finish/Color Schedule, on Architectural Drawings is not required to submit a pre-bid approval.
2. Manufacturers listed in this specification, but not in the Material Finish/Color Schedule, on Architectural Drawings shall submit color samples for pre-bid approval by addendum. Refer to Section 01 25 00.
3. When no colors are listed in the Material Finish/Color Schedule, on Architectural Drawings, any manufacturer listed in this specification are not required to submit a pre-bid approval.

2.02 PORCELAIN FLOOR TILE

A. Manufacturers: Products by Dal-Tile are specified. Products by Crossville, U.S. Ceramic, American Olean and Florida Tile are acceptable.

B. 100% Porcelain Floor Tile 2” x 2”.

2. Patterns: Provide as shown on drawings.

C. Base: Dal-Tile MB5A 2” x 2” base without bullnose and MB5B 2” x 2” base with bullnose top.

2.03 CERAMIC WALL TILE

A. Manufacturer: Products by Dal-Tile, American Olean, US Ceramics, and Florida Tile are acceptable, subject to color match approval by the Architect prior to bidding.

B. 4-1/4” x 4-1/4” glossy and trim pieces.

2. Patterns: Provide as shown on drawings.

2.04 SETTING MATERIALS

A. Manufacturers: Products and systems by Bostik Construction Products are specified. Equivalent products and systems by Ardex, Mapei, Bonsal, H.B. Fuller, Laticrete, Custom Building Products, and American Olean are acceptable subject to approval of submittals.

B. Tile Setting Systems:

1. Setting bed for tile on concrete slabs-on-grade, mortar bed, or masonry walls: Acrylic latex modified thin set meeting ANSI A118.4 and ANSI A118.11, Bostik “ReFlex” (TCNA F111 or F113).
2. Setting bed for tile on floors of showers, toilet rooms and locker rooms on above grade locations: Waterproofing membrane and setting adhesive, Bostik “UltraSet Advanced” or “Gold Plus” single step application. (TCNA F121 or F122).
4. Setting bed for tile on fiberglass faced or tile backer board: Bostik “ReFlex” at dry areas or “ReFlex” with “Gold Plus” at wet areas such as showers, toilet rooms, locker rooms (TCNA W242).

5. Setting tile over existing glazed tile/painted concrete block: Bostik “Tile Mate Premium” mixed with Flex Elastic (TCNA TR713)
   a. Dry Areas: Organic adhesive OR non-sag mortar (ANSI 118.4) “Stonewall”.
   b. Wet Areas: Only non-sag (ANSI 118.4) “Stonewall”.

6. Setting bed for tile on concrete slab-on-grade in large format tile (>24” in any direction): “Stone Wall”.

C. Mortar Bed: Mixture of portland cement and sand, roughly in proportions of 1:5 with latex polymer as the liquid portion of the mixture.
   1. Cleavage Membrane: Asphalt felt, ASTM D 226, Type I (No. 15); or polyethylene sheeting, ASTM D 4397, 4.0 mils thick.
   2. Reinforcing: Galvanized, welded wire fabric, 2 by 2 inches by 0.062 inch diameter; comply with ASTM A 185 and ASTM A82 except for minimum wire size.

D. Grout
   1. For glazed ceramic, mosaic, and porcelain tile: Acrylic latex modified grout meeting ANSI A118.7, “Bostik” Ceramic Tile Grout” mixed with Bostik “Multi-Purpose Acrylic Latex Grout Additive”.

2.05 MISCELLANEOUS MATERIALS

A. Sealant: One component silicone, color to match tile grout.

B. Silicone sealer for tile joints: “Grout Sealer” at manufactured by Aqua Mix, Inc.

C. Cleaners: As manufactured by Hillyard Chemical Company or American Olean.

D. Provide leveling system for tiles over 24” in any dimension as recommended by tile manufacturer.

E. Thresholds: Solid polymer made from homogeneous solid sheets of filled plastic resin complying with material and performance requirements in ANSI Z124.3, for Type 5 or Type 6, without precoated finish. Sizes as detailed on drawings. Colors as selected by Architect to match field color of tile.

F. Metal Trim for Tile: As manufactured by Schluter Systems, LP or equal. Material: Brushed Aluminum.
   1. CT Corner Trim: (For use at outside corners of tile to tile and terminations of ceramic/porcelain tile to other materials). RONDEC profile RO x tile height x AE.
      a. Provide, splice connectors, end caps, inside and outside corners, as warranted by application. 45° or 90° mitres will not be accepted.

2.06 EXTRA STOCK

A. Furnish 1% of each type/shape/color of tile used on this project to Owner as maintenance stock.
PART 3: EXECUTION

3.01 EXAMINATION OF SURFACES

A. Inspect surfaces to which tile is to be applied. Commencement of work implies acceptance of surface and assumption of responsibility for satisfactory results.

3.02 MORTAR BEDS

A. Mix and install mortar, cleavage membrane and reinforcing per ANSI A108.B, sloping top of mortar bed with a constant slope from walls to floor drains.

B. Allow mortar bed to fully cure prior to commencing with tile work.

3.03 SETTING BEDS

A. Use systems identified in “Setting Materials” in Part 2 of this specification.

3.04 TILE INSTALLATION

A. General

1. Installation and workmanship shall be in accordance with ANSI Specifications and as specified herein. The printed instructions of the tile manufacturer and the manufacturer of proprietary mortars and grouts shall be followed where applicable.

2. Before commencing work, establish field pattern and border line locations and center the work symmetrically so that no tile need be cut to less than half size. Cut tile at base so top of base is level around entire room. Joints in wall tile shall be aligned vertically and horizontally; staggered joints will not be accepted. Rub exposed edges smooth.

3. Do not install any cracked or chipped tiles.

B. Movement Joints

1. Install joints to control the effects of substrate movement on tile finishes.

2. Construct joints in tile work according to movement joint details” EJ171” as published in TCNA “Handbook for Ceramic Tile Installation.”

3. Locate movement joints at the following locations:

   a. Interior: 20’ to 25’ maximum in each direction.

   b. Exterior and Interior tile work exposed to direct sunlight or moisture: 8’ to 12’ maximum in each direction.

   c. Where tile work abuts restraining surfaces including but not limited to perimeter walls, dissimilar floors, curbs, columns, pipes, ceilings, inside corners of abutting walls, and where changes occur in backing materials.

   d. All expansion, control, construction, cold and seismic joints in the structure. Expansion joints in tile work must match width of joint in building structure.

C. Crack isolation membrane: Install over minor cracks and non-structural slab joints to prevent transmission of cracking to tile. Strictly follow membrane and mortar manufacturers' printed instructions.

D. Waterproofing membrane: Install per manufacturers printed instructions, including two wet on wet applications at 20-30 mils thick. Full bonding to metal and PVC.

   1. Perform 24-hour flood testing. Repeat application as required until flood test passes.
E. Install thresholds at transition from ceramic tile floors to other flooring materials and as shown on drawings.

F. Remove concrete curing compound with shot blasting or other appropriate mechanical means and vacuum floor on installations without mortar bed.

G. Existing Surface Preparation: Completely remove all paint, soap scum, wax, coatings, oil, etc. from existing surfaces to receive tile. Perform mechanical abrasion with a carborundum disk followed by a clear water wash. Use other cleaning methods of soapless detergents, commercial tile cleaners or solvents or acids if required to adequately prep surfaces. Substrate must be thoroughly rinsed and dry before setting the new tile.

3.05 CLEANING, PATCHING, PROTECTION, SEALING

A. After completion, clean all work, point open joints and replace defective work.

B. Cleaning and Sealing

1. Ceramic Porcelain Tile Walls, Floors and Base: Clean with water, rinse and allow to dry. Apply one coat of silicone sealer. Wipe excess sealer from face of tile.

C. Protection

1. Floors: Close off workspaces to traffic during installation and at least 48 hours after completion of work.

2. Finished tile floors: Covered with clean building paper before foot traffic is permitted on them. Place board walkways on floors that are to be continuously used as passageways by workmen. Protect tiled vertical outside corners with board corner strips in areas used as passageways by workmen.

3. Remove protection just prior to substantial completion and re-clean tile as necessary.

END OF SECTION 09 30 00
PART 1: GENERAL

1.01 SUMMARY

A. Section includes:
   1. Lay-in acoustic ceilings.
   2. Lay-in vinyl gypsum ceilings.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00:
   1. Submit Shop Drawings indicating installation layouts.
   2. Submit samples of all acoustical and suspension materials to Architect for approval.

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original, unopened, protective packaging, with manufacturer's labels indicating brand name, pattern, size, thickness and fire rating as applicable, legible and intact.
B. Store materials in original protective packaging to prevent soiling, physical damage or wetting.
C. Store cartons open at each end to stabilize moisture content and temperature.
D. Do not begin installation until sufficient materials to complete a room are received.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Complete installation of dampening materials before beginning work.
B. Maintain humidity of 65% - 75% in area where acoustical materials are to be installed, 25 hours before, during, and after installation.
C. Maintain a uniform temperature in the range of 55 F. to 70 F. prior to, during, and after installation of materials.

PART 2: PRODUCTS

2.01 ACOUSTICAL MATERIALS

A. Products specified are as follows:
   2. USG, www.usg.com
   4. CertainTeed Corporation
B. ACT 2: Square edge, 5/8" thick, sag and abuse resistant, anti-microbial, low VOC, lay-in tile. Provide 24” x 24” tile.
   1. Minimum NRC: 0.55
   2. Minimum CAC: 33
   3. Minimum LR: 0.81
   4. Minimum Recycled Content: 28 - 30%
   5. Armstrong “Fissured” #896
   6. Products by other manufacturers may be acceptable, subject to acceptance of Architect, prior to bidding.

C. ACT 4: White 2 mil vinyl laminated to a gypsum core, ½” thick, sag resistant, USDA approved lay-in tile. Provide 24” x 24” tiles.
   1. Minimum CAC: 35
   2. Minimum LR: 0.75
   3. Minimum Recycled Content: 19%
   4. USG Sheetrock “Clima Plus”, vinyl #3260
   5. National Gypsum: “Gridstone” # GB5044
   6. Products by other manufacturers may be acceptable, subject to acceptance of Architect, prior to bidding.

D. Furnish extra materials equal to 1% of each type of acoustical material supplied. Provide materials in new, unopened cartons labeled as to contents.

2.02 SUSPENSION SYSTEMS

A. Systems specified are by Rockfon/Chicago Metallic. Equivalent systems by USG or Armstrong are acceptable.


C. Systems for use in kitchens, kitchen serving areas, toilets and locker rooms to be 1830 intermediate duty hot dipped galvanized capped with white aluminum capping.

D. Perimeter treatment components for all systems to be 0.020 inch thick hot dipped galvanized steel, 15/16” wide x ¾” high. Edges to be hemmed. Finished identical to main runners and cross tees.

E. Impaction Clips: Manufacturer’s standard for rooms A400, A500, and A600.

PART 3: EXECUTION

3.01 CONDITION OF SURFACES

A. Examine surfaces scheduled to receive suspended or directly attached acoustical units for unevenness, irregularities, and dampness that would affect quality and execution of work.

B. Mark access provisions as to size and location before beginning installation.

3.02 REQUIREMENTS FOR ALL MECHANICAL SUSPENSION SYSTEMS

A. Grid layout in each space, area located symmetrically in room, space. Coordinate work with other trades so that lighting fixtures, grilles, other ceiling fixtures work to grid layout.

B. Do not use universal splices or other types whose use would obstruct passage of recessed lighting fixtures through grid openings, or make untenable their reposition upon flanges of beams.

C. Support suspension system from structure above, not from ductwork, equipment or piping.
D. Space hangers not more than 6” from ends, not more than 4’-0” o.c. Between ends of main runners, provide extra hangers as required to support other work resting in or on ceiling.

E. Provide additional tee supports, hangers and cut tiles to support and fit to all sides of light fixtures, linear diffusers and other ceiling penetrations. Coordinate with mechanical and electrical drawings.

3.03 ACOUSTICAL MATERIALS

A. Install ceiling panels and tiles using clean gloves, to avoid soiling materials.

B. Install lay-in panels snugly against support system without damaging panels.

C. Field rabbit edges of panels where field-cut to match shadow-line profile.

D. Adjust any sags or twists which develop in the ceiling systems and replace any part which is damaged or faulty.

E. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings and suspension members; comply with manufacturer’s instructions for cleaning and touch up of minor finish damage. Remove and replace work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

F. Replace any damaged tile just prior to substantial completion.
END OF SECTION 09 51 00
SECTION 09 65 00
RESILIENT FLOORING
ALTERNATE #2

PART 1: GENERAL

1.01 SUMMARY

A. Section includes:
   1. Vinyl base and accessories.
   2. Moisture mitigation at existing slab on grade.
   3. Luxury Vinyl Tile (LVT).

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00:
   1. Submit full line of color samples for materials to be furnished for Architect's review and selection.
   2. Provide manufacturer's recommended maintenance data and instructions prior to completion of work.
   3. Specified warranties from manufacturer. Submit per Section 01 78 23.

1.03 CONCRETE MOISTURE AND ADHESION

A. For new concrete slabs on grade, this project is utilizing a moisture vapor reduction admixture (MVRA) as specified in Section 03 30 00.
   1. The MVRA manufacturer will perform all moisture testing of new slabs on grade. No further field slab moisture or pH testing shall be required by the flooring installer. Probe type moisture tests will not provide accurate results with concrete that has MVRA admixture, as the moisture remains irremovable and suspended within the slab.
   2. The flooring installer is to perform a field bond test with the specified flooring products and the flooring manufacturer’s recommended adhesive for non-porous substrates, with the MVRA manufacturer’s representative present. The bond test shall be performed to adhesive manufacturer’s guidelines and ASTM F710.
   3. At completion of testing and prior to the installation of any flooring, the MVRA manufacturer will issue the following warranties/guarantees:
      a. Life of Concrete Warranty that states the MVRA products ability to stop moisture vapor emission from the concrete itself for the life of the concrete.
         1) Up to 25 pounds of moisture per ASTM F1869 or 100% RH per ASTM F2170.
      b. Adhesion Guarantee stating the MVRA manufacturer will guarantee and warrant that the materials bond tested will adequately bond directly to the MVRA dosed concrete.
1.04 FLOOR FLATNESS

A. For new concrete slabs on grade and elevated structural slabs/topping as specified in Section 03 30 00 floor flatness is specified per ACI 117 as follows:

1. F (F) Flat tolerance with an overall value of 35 and a minimum localized value of 21.
2. F (L) Flat tolerance with an overall value of 25 and a minimum localized value of 15.
3. Measured by a manual straightedge method a “flat” floor surface classification, maximum gap for 90% compliance, samples not to exceed ¼” and for 100% compliance, samples not to exceed 3/8”.

B. The flooring contractor will be responsible to provide the necessary means (i.e., grinding/leveling) for additional leveling as required by the flooring manufacturer.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in manufacturer's original, unopened containers with labels indicating brand names, colors and patterns, and quality designations legible and intact.

B. Do not open containers or remove markings until materials are inspected and accepted.

C. Store and protect accepted materials in accordance with manufacturer's directions and recommendations.

D. Unless otherwise directed, store materials in original containers at not less than 70° F. for not less than 24 hours immediately before installation.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature in space to receive tile between 70° F. and 90° F. for not less than 48 hours before and 48 hours after installation.

B. Maintain minimum temperature of 65° F. thereafter.

1.07 WARRANTY

A. Luxury Vinyl Tile (LVT):

1. 10 year manufacturing and installation integrity.

PART 2: PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Manufacturers listed in this specification are approved under the following conditions:

1. A manufacturer listed in both the specification and the Material Finish/Color Schedule, on Architectural Drawings is not required to submit a pre-bid approval.
2. Manufacturers listed in this specification, but not in the Material Finish/Color Schedule, on Architectural Drawings shall submit color samples for pre-bid approval by addendum. Refer to Section 01 25 00.
3. When no colors are listed in the Material Finish/Color Schedule, on Architectural Drawings, any manufacturer listed in this specification are not required to submit a pre-bid approval.
2.02 LUXURY VINYL TILE (LVT)

A. Product specified are manufactured by Armstrong World Industries. Other manufacturers that meet the requirements of this specification are acceptable.

1. Resilient Flooring consisting of clear, unfilled, polyurethane-coated, 0.020 inch thick wear layer composed of polyvinyl chloride resins, plasticizers, stabilizers, and processing aids over a printed film on an intermediate layer over a filled vinyl backing. “Standard Specification for Solid Vinyl Tile”, Class III, Type B, Embossed Surface.
2. Standards: Meet or exceed requirements of ASTM F 1700.
3. Gauge and Size: Match existing.
4. Flammability: Provide materials with 0.45 CRF (critical radiant flux) or higher when tested in accordance with ASTM E 648, Flooring Radiant Panel Test.
5. Smoke Density: Provide materials with smoke density of less than 450 when tested in accordance with ASTM E662.
6. Static Load: Provide materials with static load limit of 250 psi or higher.
8. Patterns: Ashlar.

B. Adhesives:

1. S-288 Premium Commercial Vinyl Sheet Flooring Adhesive, water based resin, less than 14 g/l, VOC adhesive for above grade.
2. S-543 Premium Plus Commercial Vinyl Sheet Floor Adhesive, water based synthetic polyer, zero regulated VOC, high-moisture area adhesive for slab on grade installation.

2.03 VINYL BASE

A. Manufacturer: Products by Johnsonite are specified. VPI, Armstrong, Burke, Roppe, Tarkett are acceptable.

B. Base: 1/8" thick x 4" high, solid vinyl. Straight base at carpet, coved base at other surfaces.

C. Color: See Material Finish/Color Schedule, on Architectural Drawings.

2.04 MOISTURE MITIGATION SYSTEM

A. Conform to the requirements of Section 09 96 56 Epoxy Moisture Mitigation Systems.

2.05 ACCESSORIES

A. Adhesives, Other Application Material: As recommended specifically by flooring manufacturer.

B. Subfloor Filler: Hydraulic/Portland cement based material designed for providing thin solid surface for leveling and for minor ramping of subsurface to adjacent floor finishes.

1. Use material capable of being applied and feathered out to adjacent floor without spalling.

C. Crack and Joint Treatment: ARDEX ARDIFIX or equal (dormant cracks), two part, low viscosity rigid polyurethane and/or ARDEX ARDISEAL or equal (moving joints and cracks), rapid plus fast setting semi-rigid joint sealant.

D. Substrate Prep: ARDEX MRP or equal, moisture resistant patch.

E. Self Leveling Topping (Underlayment): ARDEX K15 or equal, Portland Cement-based, self leveling topping.

1. Transition/Reducer strips must be provided at all floor type transitions occurring within a room not at a door. Refer to accessories manufacturer for appropriate transition/reducer profile required for specified floor types.

2.06 EXTRA STOCK

A. Furnish 1% of each type/color of flooring, trim used in this project to Owner as maintenance stock.

PART 3: EXECUTION

3.01 PREPARATION

A. Surfaces to receive resilient finishes: Dry, clean, smooth. Fill defects or grind smooth as required. Sand subfloors to remove mortar, paint, other surface irregularities.

B. Buff out the concrete curing compound with a scouring pad on a buffer or other recommended procedure prior to installing adhesives for flooring.

C. Correct adverse conditions of any type before starting any flooring installation.

D. Slab preparation and moisture mitigation installation to be per manufacturer's instructions.

E. Where filling, patching, leveling is required of thickness exceeding 1/8” apply latex type underlayment in two or more applications. Apply compound in accordance with Manufacturer's printed instructions. Achieve a substrate that is flat to within 1/8” in 10’.

1. On remodeling projects, assume 33% of area will require filling, patching, or leveling.

F. Beginning of installation means installer has accepted substrate as acceptable.

G. Install flooring only after finishing operation has been completed and permanent heating system is in operation. Moisture content of concrete slabs, building air temperature and relative humidity must be within limits recommended by flooring manufacturer.

H. Terminate resilient flooring at centerline of door openings where adjacent floor finish is dissimilar.

3.02 LUXURY VINYL TILE (LVT)

A. Install flooring in strict accordance with the latest edition of “Armstrong Guaranteed Installation System, F-5061”.

3.03 MOISTURE MITIGATION SYSTEM

A. Verify moisture drive by installing Wagner Moisture Meters (or equivalent) at frequencies recommended by flooring and moisture mitigation manufacturer.

B. Prep subfloor and cracks per manufacturers recommendations.

C. Install moisture control system, primer and self leveling topping per manufacturers requirements.

3.04 ACCESSORIES

A. Place resilient reducer strips tightly butted to resilient flooring and secure with adhesive. Provide edging strips or cap strips at all unprotected edges of flooring.
B. Apply coved base at resilient floors and carpeted floors.

C. Install non-slip strips on ramps, vestibules 6” o.c.

3.05 DEMONSTRATION

A. Engage factory-authorized representatives to train Owner’s maintenance personnel on proper waxing and cleaning procedures for each floor product. Refer to Section 01 79 00 Demonstration and Training.

3.06 INSTALLATION

A. Moisture control to be installed per manufacturer’s instructions.
PART 1: GENERAL

1.01 SUMMARY

A. Section includes:

1. Field finish all materials scheduled and/or specified for paint, trim, stain or seal. Including but not limited to:
   a. Interior masonry
   b. Steel
   c. Gypsum Board
   d. Plaster
   e. Painted wall pattern

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00:

1. Provide three (3) copies of a schedule detailing each substrate in the same order as the schedules used in Part 2 of this section. Include the following:
   a. The specific products to be used for each coat.
   b. Documentation that the manufacturer has reviewed and approved each painting system.
   c. Data pages for all products listed, highlight the following:
      1) Type of resin.
      2) Dry Film Thickness.
      3) Volume Solids.
      4) Units of Sheen.
      5) VOC content and chemical components.
      6) Other performance or descriptive data required by Part 2 of this section.
      7) If this information is not on the data page provide the information in a letter of certification from the manufacturer. Attach the letter to the appropriate data page.

2. Submit three (3) drawdowns of each product and color combination. Drawdowns shall be applied using a 4 mil WFT drawdown bar on Leneta form WD plain white coated cards size 3-7/8” x 6”.
   a. Label each card with the following:
      1) Job name.
      2) Date.
      3) Product name.
      4) Product number.
      5) Color number as stated in the material finish/color schedule.
      6) Name, address, and phone number of the supplying facility.
      7) Surface material product is to be applied onto.

3. Do not deliver material to site until having received written approval of submitted information and samples.
4. Complete sample area on project as selected by Architect on each type surface and with each type of paint system specified. Do not proceed further with application until receiving acceptance of each sample area by Architect. Accepted areas will serve as standard of quality for entire project.

1.03 EXAMINATION OF DOCUMENTS

A. Examine the specifications for the work of other trade contractors and to become familiar with their work. All surfaces that are left unfinished by the requirements of other specifications to be finished by this section.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use, in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg. F.

   1. Maintain containers in clean condition, free for foreign materials and residue.
   2. Remove rags and waste from storage areas daily.

1.05 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 degrees F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.

C. Do not apply coatings during cold, rainy or frosty weather.

D. Do not apply to surfaces, which are exposed to hot sun.

1.06 QUALITY ASSURANCE

A. MPI Standards:

   1. Products: Complying with MPI standards indicated and listed in “MPI Approved Products List.”

   2. Preparation and Workmanship: Comply with requirements in “MPI Architectural Painting Specification Manual” for products and paint systems indicated.

   3. Previously Painted Surface Preparation and Workmanship: Comply with requirements in “MPI Maintenance and Repainting Manual” for products and paint system indicated.

PART 2: PRODUCTS

2.01 PAINTING SYSTEMS

A. Painting systems for normal applications are specified using the products of Sherwin-Williams Co. (S-W); PPG Paints: (PPG) and Glidden Professional: (GP); Benjamin Moore & Co.: (BM) to establish standards of quality, except as noted.

   1. Other manufacturers can submit for approval through the pre-bid process defined in Section 01 25 00 Substitutions and Product options.

       a. For approval, submit data sheets for each paint type with volume solids and VOC’s highlighted to indicate they meet or exceed products specified in Part 2.
B. Painting systems for specialty applications are specified using the products of Aquarius Coatings, Carboline, Seal-Krete, Rosco, Sika Corporation and manufacturers listed in 2.01A.

C. Use the materials of the same manufacturer for each system.

D. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Flat Paints, Coatings, and Primers VOC content of not more than 50 g/L.
2. Non-flat Paints, Coatings and Primers: VOC content of not more than 150 g/L.
3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
4. Floor Coatings: VOC not more than 100 g/L.
5. Shellacs, Clear: VOC not more than 730 g/L.
6. Shellacs, Pigmented: VOC not more than 550 g/L.

E. For color selection see Material Finish/Color Schedule, on Architectural Drawings.

2.02 PRIMERS (INTERIOR AND EXTERIOR)

A. 100% Acrylic, Interior Alkali Resistant Primer:

1. Minimum Volume Solids: 24%.
2. Maximum VOC: 150 g/L
3. Alkali Resistance: Tolerance of PH levels up to 13.
   a. S-W Loxon Concrete and Masonry Primer A24W8300
   b. GP Gripper Interior/Exterior Primer Sealer 3210-1200.
   c. PPG Perma-Crete Int/Ext Alkali Resistant Primer, 4-603.
   d. BM Super Spec High Building Masonry Primer N068.

B. 100% Acrylic Interior Primer:

1. Shall be certifiable for use on gypsum drywall or wood, and paint.
2. Minimum Volume Solids: 35%.
3. Maximum VOC: 150 g/L
   a. S-W Multi Purpose Latex Primer / Seal B51W8020
   b. GP Gripper Interior/Exterior Primer Sealer 3210-1200.
   c. PPG Seal Grip Int/Ext Acrylic Universal Primer/Sealer, 17-921.
   d. BM Fresh Start High Hiding All Purpose Primer N046.

C. Rust-inhibitive Waterborne Acrylic Primer:

1. Minimum Volume Solids: 37%.
2. Maximum VOC: 250 g/L
   b. PPG Pitt-Tech Int/Ext Primer DTM, 90-712.
   c. BM Corotech Waterborne DTM Metal Primer/Finish V110.

D. Wallcovering Primer:

1. Minimum Volume Solids: 30%.
2. Maximum VOC: 150 g/L
   b. GP Gripper Interior/Exterior Primer Sealer 3210-1200.
   c. PPG Seal Grip Acrylic Universal Primer, 17-921.
d. BM Fresh Start High Hiding All Purpose Primer N046.

E. Wash Primer:

1. Minimum Volume Solids: 27%.
2. Maximum VOC: 400 g/L
   a. S-W DTM Wash Primer B71Y1
   b. PPG Multi Prime Epoxy Primer, 94-109.
   c. BM Corotech Waterborne Bonding Primer V175.

F. Existing Painted Surface Primer:

1. Minimum Volume Solids: 28%.
2. Maximum VOC: 100 g/L
   b. GP Gripper White Interior/Exterior Primer and Sealer GL 3210-1200.
   c. PPG ACR1-Shield Acrylic Bonding Primer.
   d. BM Stix Waterborne Bonding Primer SXA-110.

2.03 BLOCKFILLERS (INTERIOR AND EXTERIOR)

A. Vinyl Acrylic Blockfiller:

1. Minimum Volume Solids: 44%.
2. Maximum VOC: 150 g/L
   b. GP Concrete Coatings Block Filler Interior/Exterior Primer 3010-1200.
   c. PPG Speedhide Interior/Ext Masonry Block Filler, 6-7.
   d. BM Corotech Acrylic Block Filler V114.

2.04 INTERIOR FINISH PAINTS

A. Vinyl Acrylic Interior Eggshell Finish:

1. Minimum Volume Solids: 35%.
2. Maximum VOC: 0 g/L
   b. GP No VOC Interior Eggshell, 1411.
   c. PPG Speedhide Interior Eggshell 6-4310XI.
   d. BM Ultra Spec 500 Interior Eggshell 538.

B. Vinyl Acrylic Interior Flat Finish:

1. Minimum Volume Solids: 32%.
2. Maximum VOC: 0 g/L
3. Sheen: 0-8 units at 85 degrees.
   b. GP No VOC Interior Flat 150, 1209
   c. PPG Speedhide Interior Flat 6-4110XI.
   d. BM Ultra Spec 500 Interior Flat 536.

C. 100%, Modified Acrylic, Interior Semi-Gloss Coating:

1. Minimum Volume Solids: 33%.
2. Maximum VOC: 150 g/L
   a. S-W Pro Industrial Pre-Catalyzed Epoxy.
b. GP Lifemaster Oil Interior/Exterior Semi-Gloss Paint 1506.
c. PPG PITT-GLAZE WB1 Interior Semi-Gloss Pre-Catalyzed Water-Borne Acrylic Epoxy.
d. BM Corotech WB Pre-Cat Epoxy Coating Semi-Gloss V341.

D. 100% Acrylic, Waterborne Egg-Shel Dryfall:

1. Minimum Volume Solids: 30%.
2. Maximum VOC: 150 g/L
3. Sheen: 0-8 units at 85 degrees.
   b. GP Waterbased Interior Eggshell Dry Fall 1482-1200.
   c. PPG Speedhide Super Tech Flat Eggshell 0-5 @60&85 Dry Fall, 6-725 XI.
   d. BM Super Spec Sweep Up Flat Sheen 6@85, 153.

E. Single-component, Egg-Shel Waterbased, Pre-Catalyzed Epoxy:

1. Minimum Volume Solids: 37%
2. Maximum VOC: 150 g/L
3. Sheen: 25-35 units at 85°
   a. S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy (Egg Shell K45)
   b. PPG Pitt-Glaze WB1 Interior Pre-Catalyzed Waterborne Acrylic Epoxy
   c. BM Corotech High Performance Pre-Catalyzed Waterborne Epoxy Eggshell V342

2.05 EXTRA STOCK

A. Provide left over paint with Owner for touch-up purposes. At completion of project, provide one complete set of drawdowns in each maintenance manual with a schedule noting the locations each paint color was used. Refer to Section 01 78 39.

PART 3: EXECUTION

3.01 PREPARATION OF SURFACES

A. General

1. Comply with manufacturer’s written instructions and recommendations in “MPI Architectural Painting Specification Manual” applicable to substrates indicated.

2. Do not start work until preparation specified in surface Section is completed.

3. Ensure surfaces are dry and adequately protected from dampness.

4. Thoroughly clean surfaces free of loose, rough and foreign substances which will affect adhesion or appearance of applied coats.

5. Remove mildew and neutralize surface.

6. Remove plates, machined surfaces, and similar items already in place that 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.

   a. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
   b. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
7. Complete repainting or refinishing will be required if coats are applied over improperly prepared surfaces.

B. Gypsum Board:

1. Fill minor irregularities with patching material and sand to smooth level surfaces taking care not to raise nap of paper.

2. Previously painted gypsum wallboards must be completely dry, smooth-sanded, clean and free of dust, dirt, powdery residue, grease, oil, wax or any other contaminants such as flaking or peeling paint before paint application is started. Treat or remove all contaminants and correct defects. Dull glossy old paint by light sanding or with a commercial deglosser/cleaner to assure maximum adhesion of the new coating. Patch holes and cracks with a latex patching compound, sand smooth and spot prime with the paint or enamel to be used as the final coat.

C. Plaster

1. Fill cracks, holes or imperfections with patching plaster and smooth off to match adjoining surfaces. Do not sandpaper.

2. In case of high alkali or lime conditions, neutralize with solution recommended by paint manufacturer.

3. Do not paint until moisture content of surface is 12% or below, except as may be required by paint manufacturer.

4. Previously painted plaster surfaces must be dry, clean, and free of dust, dirt, powder residue, grease, oil, wax or any other contaminants; free of flaking, crumbling or chalking conditions before paint application is started. Contaminants must be treated or removed. Defects corrected as necessary. Dull glossy old paints by light sanding or with deglosser/cleaner to assure maximum adhesion of the new coating. Remove any loose, chipped, peeling or blistered old paint by scraping and smooth sanding. If highly porous old paint needs reconditioning before receiving the new application, prime the entire surface with undercoater oil primer. Patch holes and cracks with latex patching compound per manufacturer’s instructions after removing plaster as far back as necessary to reach firm areas. Spot prime patched areas with sealer-primer.

D. Masonry

1. Do not paint until moisture content of surface is 15% or below except as may be required by paint manufacturer.

2. After prime coat is dry, fill remaining small holes, cracks and other defects with Swedish putty made by mixing dry spackle with prime paint.

3. Previously painted masonry surfaces must be dry, clean and free of dust, dirt and any other contaminants. Hard glossy surfaces are to be lightly sanded or dulled with deglosser/cleaner. Surfaces in poor condition must be prepared for repainting by removing loose paint and blisters by scraping, sanding or burning. Paint in these areas are to be removed at least 12 inches beyond the failing area. Patch all holes left after removal of nails, screws, and anchors. Prime before applying finish coats.

E. Ferrous or Galvanized Metal

1. Remove dirt and grease with mineral spirits or solvent recommended by paint manufacturer and clean cloths.

2. If prime coat is not smooth, sand to bare metal, reprime. Touch up scratched or abraded primer.
3. Previously painted metal must be dry, clean and free of contaminants. Hard and glossy surfaces are to be sanded lightly or dulled with deglosser/cleaner. Remove peeling, loose, chipped, and blistered paint and rust by scraping and sanding. Prime all sanded areas and areas devoid of paint with an all-purpose metal primer.

3.02 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent
2. Masonry: 12 percent
3. Wood: 15 percent
4. Gypsum Board: 12 percent
5. Plaster: 12 percent

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

E. Conditions

1. Do no work when surface, coating product, air temperature, humidity or dewpoint does not meet requirements of PROJECT CONDITIONS in Part 1 of this specification.
2. Do no interior work until building is properly enclosed.
3. Do work under adequate illumination and dust-free conditions.

3.03 APPLICATION

A. Methods: Paint may be applied by brush, roller or spray methods except where particular method will produce unsatisfactory results. Where spray method is used on concrete block, follow with roller to work paint into voids.

B. Materials: Do not open containers until required for use. Stir materials thoroughly and keep at uniform consistency during application.

C. Coats

1. Number specified is minimum. Provide sufficient number of coats to provide even, consistent, opaque coverage of substrate.
2. Touch up suction spots between coats.
3. Refinish surfaces affected by refitting work.
4. Tint prime and under coats of paint approximately 1/2 to 3/4 depth of final color.
5. Touch up suction and "hot" spots in plaster and concrete after application or first coat and before second coat.
6. Do not apply next coat until previous is thoroughly dry.
7. Provide final coat which is solid and even in color; free from runs, laps, sags, brush marks, air bubbles and excessive roller stipple and worked into crevices, joint and similar areas.

8. Do not paint sealant / sealant joints.

3.04 SCHEDULE OF INTERIOR WORK

A. General

1. Paint complete all surfaces noted with a "PT" on Room Finish Schedule.
   a. New Work: In rooms with surfaces not scheduled for paint on Room Finish Schedule, paint hollow metal doors and frames, metal stairs and railings as occur.
   b. Existing Areas:
      1) Remodeling work: In rooms with surfaces scheduled for paint on Room Finish Schedule, paint hollow metal doors and frames, metal stairs and railings as occur.
      2) In unscheduled areas where patching has occurred, paint all walls corner to corner and floor to ceiling. Match adjacent wall color. Paint both sides of doors and frames at locations where replacement or modifications have been made.

2. Provide specified finish on exposed surfaces including, but not limited to the following:
   a. Prime coated mechanical units, piping, pipe covering, sprinkler piping, interior duct surfaces visible behind grilles, tanks without factory finish, radiation covers, cabinet unit heaters, exposed ductwork, louvers and grilles.
   b. Electrical panel box covers and surface raceways (over factory finish), conduits and boxes and all factory primed electrical equipment. (Except in maintenance, service and electrical rooms).
   c. Hollow metal doors and frames, steel stairs, ladders and railings, catwalks and safety mesh grilles, access panels, prime painted hardware, painted astragals and vision lite kits on doors, coiling grilles and doors (unless factory finished), metal supports for counters and exposed miscellaneous metals.
   d. Plywood backboards for electrical panels/devices and low voltage. Color to match adjacent wall surface or panelboards on unistrut mounted backboards.

3. Do not paint sealant.

4. DO NOT paint low voltage cabling, as it voids the warranty.

5. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

6. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

7. Partition Identification
   a. Place identification on all partitions indicated on Code Drawings as having a required fire or smoke rating.
b. Identification shall be as follows:

1) Rating (i.e. 2 HR Fire Wall; Smoketight; 2 HR Fire Barrier): Same as indicated on Code Drawing Legend.

2) Location: With-in 15 feet at the end of each wall and a maximum of 30 feet on center, both sides of partitions, above ceiling line and below access floors. Provide at least one location on each wall face.
   a) Place above access panels in hard ceilings.

3) Style of Lettering: 3 inches high, Arial Bold style, painted with aid of stencils.

4) Color: Red.

B. Concrete Masonry Units and Restored Masonry (not scheduled for epoxy):

1. 1st Coat (New Surfaces): Vinyl Acrylic Blockfiller.
   (1st Coat Option due to schedule constraints: 100% Acrylic Exterior Masonry Primer).
   a. Minimum DFT: 8.0 mils (75-125 sq. ft./gal).

2. 1st Coat (Existing Surfaces): Existing Painted Surface Primer.
   a. Minimum DFT: 0.9 mils.

3. 2nd and 3rd Coat: Vinyl Acrylic Interior Eggshell Finish.
   a. Minimum DFT: 1.5 per coat.

C. Gypsum Drywall – Wall (not scheduled for epoxy):

1. 1st Coat (New Surfaces): 100% Acrylic Interior Primer.
   a. Minimum DFT: 1.5 mils.

2. 1st Coat (Existing Surfaces): Existing Painted Surface Primer.
   a. Minimum DFT: 0.9 mils.

3. 2nd and 3rd Coat: Vinyl Acrylic Interior Eggshell Finish.
   a. Minimum DFT: 1.5 per coat.

D. Gypsum Drywall – Soffits/Ceilings (not scheduled for epoxy):

1. 1st Coat (New Surfaces): 100% Acrylic Interior Primer.
   a. Minimum DFT: 1.5 mils.

2. 1st Coat (Existing Surfaces): Existing Painted Surface Primer.
   a. Minimum DFT: 0.9 mils.

3. 2nd and 3rd Coat: Vinyl Acrylic Interior Flat Finish.
   a. Minimum DFT: 1.4 per coat.

E. Plaster – Walls (not scheduled for epoxy):

1. 1st Coat (New Surfaces): 100% Acrylic, Interior Alkali Resistant Primer.
   a. Minimum DFT: 3.0 mils.

2. 1st Coat (Existing Surfaces): Existing Painted Surface Primer.
   a. Minimum DFT: 0.9 mils.

3. 2nd and 3rd Coat: Vinyl Acrylic Interior Eggshell Finish.
   a. Minimum DFT: 1.5 per coat.

F. Plaster – Ceilings (not scheduled for epoxy):

1. 1st Coat (New Surfaces): 100% Acrylic, Interior Alkali Resistant Primer.
   a. Minimum DFT: 3.0 mils.

2. 1st Coat (Existing Surfaces): Existing Painted Surface Primer.
   a. Minimum DFT: 0.9 mils.

3. 2nd and 3rd Coat: Vinyl Acrylic Interior Flat Finish.
   a. Minimum DFT: 1.4 per coat.
G. Gypsum Drywall – Walls (scheduled to receive epoxy except showers):

1. 1st Coat (New Surfaces): 100% Acrylic Interior Primer.
   a. Minimum DFT: 1.5 mils.
   b. Minimum DFT: 0.9 mils.
2. 1st Coat (Existing Surfaces): Existing Painted Surface Primer.
   a. Minimum DFT: 0.9 mils.
3. 2nd and 3rd Coat: Single-component, Eg-Shell Waterbased Pre-Catalyzed Epoxy

H. Concrete Masonry Units and Restored Masonry (scheduled to receive epoxy except showers):

1. 1st Coat (New Surfaces): Vinyl Acrylic Blockfiller.
   (1st Coat Option due to schedule constraints: 100% Acrylic Exterior Masonry Primer).
   a. Minimum DFT: 8.0 mils.
2. 1st Coat (Existing Surfaces): Existing Painted Surface Primer.
   a. Minimum DFT: 0.9 mils.
3. 2nd and 3rd Coat: Single-component, Eg-Shell Waterbased Pre-Catalyzed Epoxy

3.05 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.06 FIELD QUALITY CONTROL

A. Testing and Painting Application: Owner reserves the right to test DFT of painted surfaces.

1. If testing discovers that DFT of installed paint does not meet specification, the Contractor will pay for initial and final testing and recoat surfaces until testing agency confirms specification is met.

END OF SECTION 09 91 00
PART 1: GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnish all labor, materials, tools and equipment as necessary to perform installation of a surface applied moisture mitigation system (vapor retarder) with cementious covering over on new and/or existing concrete slabs free of oil contamination or previously treated with a sealer, for slab on grade conditions with the following flooring:
   a. LVT

2. Repairs and preparation of concrete floors.

1.02 SUBMITTALS

A. Submit in accordance with Section 01 33 00.

1. General: Submit manufacturer's certification that proposed materials, details and systems as indicated and specified fully comply with manufacturer's details and specifications. If any portion of Contract Documents do not conform to manufacturer's standard recommendations, submit notification of portions of design that are at variance with manufacturer's specifications.

2. Product Data:

   a. Submit manufacturer's literature, installation instructions for each product.

   b. Test data: Submit independent testing laboratory data for product, evidencing:
      1) Up to 97% reduction of water vapor transmission (tested as per ASTM E 96-95).
      2) Product is insensitive to alkaline environment up to pH 14 (tested as per ASTM D 1308).

   c. Written confirmation from the manufacturer to proceed with installation approving issuance of warranty.

B. Submit the following per Section 01 78 23:

1. Sample of warranty

2. Maintenance instructions

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Company specializing in manufacturing products specified in this Section with minimum 5 years documented experience.
B. Installer Qualifications:
   1. Manufacturer licensed applicator.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in original packaging, labeled with product identification, manufacturer, batch number and shelf life.

B. Store products in a dry area with temperature maintained between 50° and 85° F (10° and 29° C) and Protect from direct sunlight.

C. Handle products in accordance with manufacturer's printed recommendations.

1.05 SYSTEM REQUIREMENTS

A. Coordinate installation with other trades.

B. Provide materials and accessories in timely manner so as not to delay Work.

1.06 PROJECT CONDITIONS

A. Do not install material below 50° F (10° C) surface and air temperatures. These temperatures must also be maintained during and for 48 hours after the installation of products included in this section. Install quickly if substrate is warm and follow warm weather instructions available from the manufacturer.

1.07 WARRANTY

A. Moisture Control system need to reduce moisture emissions coming from concrete slab to a rate slow enough that the flooring system – adhesive and floor covering will not be affected.

B. 20-year manufacturer material and labor warranty.

PART 2: PRODUCTS

2.01 MANUFACTURERS


B. The following equivalent systems that meet the intent of this specification are acceptable:

   1. HPS North America/Schonox EPA Rapid.

2.02 MATERIALS

A. Single-coat, fast curing, 100% solids epoxy moisture control system: ARDEX MC™ RAPID.

B. Performance and Physical Properties: Meet or exceed the following values for material cured at 70° F+/-3°F (21° C+/-3°C) and 50% +/-5% relative humidity:

   2. Material Requirements on CSP 3 Prepared Concrete: Approx. 250 - 270 sq. ft. per mixed unit for 10 mils, and approx. 170 – 109 sq. ft. per mixed unit for 14 mils.
   3. Permeability (ASTM E96): <0.10 perms.
5. Working Time: 20 minutes.
6. Pot Life: 20 minutes.
7. VOC: 19.9 g/L, A+B, ASTM D2369.
8. Walkable: Minimum of 4 hours.
9. Install Underlayment: Minimum 4 hours.

C. Hydraulic Cement-based Self-Leveling Underlayment: ARDEX K 15®

1. Performance and Physical Properties: Meet or exceed the following values for material cured at 70° F +/- 3°F (21° C +/- 2°C) and 50% +/- 5% relative humidity:
   a. Application: Barrel Mix or Pump
   b. Flow Time: 10 minutes
   c. Walkable: 2 to 3 hours
   d. Compressive Strength: Minimum 5,500 psi (385 kg/cm2) at 28 days, ASTM C109M.
   e. Flexural Strength: 1,200 psi (84 kg/cm2) at 28 days, ASTM C348.
   f. VOC: 0

2.03 WATER

A. Water shall be clean, potable, and sufficiently cool (not warmer than 70°F).

2.04 MISCELLANEOUS MATERIALS

A. Pre-smoothing materials: ARDEX K301 Self-Leveling Exterior Concrete Topping, ARDEX MRP Moisture Resistant Patch or ARDEX K 60 ARDITEX.

B. Crack filler: ARDEX ARDIFIX.

C. Joint filler: ARDEX ARDISEAL RAPID PLUS.

D. Flexible sealing compound: ARDEX ARDISEAL RAPID PLUS

PART 3: EXECUTION

3.01 PREPARATION

A. Concrete Subfloors: Prepare substrate in accordance with manufacturer’s instructions.

1. Prior to proceeding please refer to ASTM F710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring. All concrete subfloors must be sound, solid, clean, and free of all oil, grease, dirt, curing compounds and any substance that might act as a bond breaker before application.

2. Mechanical preparation of the surface is required to obtain a minimum ICRI concrete surface profile of 3 (CSP 3). This substrate preparation must be by mechanical means, such as shot blasting.

3. Prior to beginning the installation, the relative humidity within the concrete can be measured (ASTM F2170). No standing water shall be present.

4. If the concrete substrate is too uneven to provide a uniform film thickness of the moisture mitigation product (typically CSP 6 or higher), the substrate can be pre-smoothed using pre-smoothing materials.
   a. Contractor to assume 20% of the existing slab will require pre-smoothing.
5. For Portland Cement-based Self-Leveling, Self-Drying Topping:
   
a. All dormant cracks must be pre-filled with crack filler in strict accordance with the installation instructions provided by the manufacturer’s Technical Service Department. Once the dormant cracks have been properly filled, broadcast sand to refusal, and allow these areas to cure thoroughly. Remove all excess sand prior to proceeding with the moisture mitigation product installation.

b. All joints, including control joints, expansion joints and isolation joints, and moving cracks must be honored up through the moisture mitigation product, the Portland cement based topping and the sealer by installing a fully flexible sealing compound.

6. For Hydraulic Cement-based Self-Leveling Underlayment:
   
a. Dormant control joints and dormant cracks greater than a hairline (1/32”) must be pre-filled with crack filler. Dormant cracks and dormant control joints must be filled in strict accordance with the installation instructions provided by the manufacturer’s Technical Service Department. Once the dormant cracks and dormant control joints have been filled properly, broadcast sand to refusal, and allow these areas to cure thoroughly. Remove all excess sand prior to proceeding with the moisture mitigation product installation.

b. All moving joints and moving cracks must be honored up through the moisture mitigation product, the underlayment and the floor covering by installing a fully flexible sealing compound designed specifically for use in moving joints.

3.02 APPLICATION OF MOISTURE MITIGATION PRODUCT

A. Examine substrates and conditions under which materials will be installed. Do not proceed with installation until unsatisfactory conditions are corrected.

B. Coordinate installation with adjacent work to ensure proper sequence of construction. Protect adjacent areas from contact due to mixing and handling of materials.

C. Mixing: Comply with manufacturer's printed instructions and the following.
   
   1. Each individual 22 lb. unit contains separate, pre-measured quantities of hardener (Part B) and the resin (Part A). After opening each container, stir the individual components thoroughly before blending. The hardening agent (Part B) is added to the resin (Part A).

   2. Pour all of the hardener into the resin portion and stir thoroughly for a minimum of 3 minutes using a low speed drill and an epoxy mixing paddle. Once mixed, pour some of the epoxy back into the hardener container, stir for 10 seconds, and then pour all of the contents back into the resin container. Mix for an additional 30 seconds before applying.

D. Application: Comply with manufacturer's printed instructions and the following.

   1. The required thickness for the moisture mitigation product is dependent on application. Refer to manufacturer’s technical data sheet for more information.

   2. Apply the freshly mixed moisture mitigation product at the minimum thickness specified in the technical data sheet to the prepared concrete surface in a uniform direction with a short-nap paint roller or notched squeegee with back-rolling for smoother surfaces, and a longer nap roller for more uneven substrates. To minimize the potential for pinhole formation, work the moisture mitigation product into the surface with the roller to ensure maximum penetration. The moisture mitigation product can also be worked into the surface with a paintbrush for hard to reach areas and corners.
3. A sand broadcast is required for certain applications; see the technical data sheet. Where required, sand broadcast must proceed while the moisture mitigation product is still in a fresh state (maximum 20 minutes).

4. Following the application of the moisture mitigation product and primer or sand broadcast, install the underlayment in accordance with printed instructions found in the manufacturer’s corresponding technical brochure.

5. It is not necessary to re-test the substrate for moisture emissions prior to installing the floor covering.

3.03 ACCEPTANCE / PROTECTION

A. Remove left over materials and any foreign material resulting from the work from the site.

B. Clean adjacent surfaces and materials.

C. If the underlayment or finish flooring is not to be installed immediately, the surface of the moisture mitigation system shall be protected from abuse by other trades with the use of plywood, masonite or similar materials.
END OF SECTION 09 96 56
SECTION 10 21 13
SOLID PLASTIC TOILET PARTITIONS

PART 1: GENERAL

1.01 SUMMARY
A. Section includes: Provide and install toilet partitions and urinal screens as indicated on drawings.

1.02 SUBMITTALS
A. Submit the following in accordance with Section 01 33 00:
   1. Product data for compartments, panels, finishes, hardware, and accessories.
   2. Shop drawings, showing partition plans, elevations, field verified, dimensions, door swings, details for supports, and method of anchorage.
   3. Samples of manufacturer’s colors/finishes.
   4. Installation instructions.
   5. Submit the following per Section 01 78 23.
      a. Maintenance instructions.
      b. Copy of warranty.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING
A. Deliver compartments in suitable crating or packaging to prevent damage in transit and storage.
B. Coordinate delivery to reduce period of on-site storage. Store under cover in a dry area.

1.05 QUALITY ASSURANCE
A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

   Class C: 200
   1. Flame-Spread Index: 200 or less.
   2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in Americans with Disabilities Act (ADA) and local Building Code.

1.06 WARRANTY
A. Provide 15 year warranty to cover panels, doors, and pilasters against breakage, delamination, and corrosion. Submit per Section 01 78 23.
PART 2: PRODUCTS

2.01 POLYMER RESIN PARTITIONS

A. Products produced by General Partitions Mfg. Corp. are specified. Other manufacturers with products that conform to requirements of specification are acceptable.

1. Construction
   a. Toilet Partition Type: Floor mounted overhead braced “Series 40”. Panel height between 55”-60”.
   b. Doors: 24” wide x 55” high unless noted otherwise. Accessible stall doors shall have minimum clear width of 32” x 55” high.
   c. Urinal Screens: Wall mounted. 18” x 42” – 55”.
   e. Accessories: Combination coat hook and bumper (for all stalls).
   f. Hardware: Include gravity style self closing continuous hinge and bracket assemblies, steel bar saddle for attachment to floor or ceiling with threaded steel studs and leveling studs, pilaster shoes, aluminum anti-grip headrail on panels, door latches with emergency access, door handles, door strikes and keepers. Provide continuous anchor strip to attach panels to walls. Finish: Aluminum or stainless steel.
   g. Fasteners: Stainless steel. Provide theft-proof head thru-bolt sex bolt fasteners at hinge brackets, keeper and strike with rubber bumper.

2. Panels
   a. Material: Molded under pressure from high density polymer resin in uniform color throughout.
      1) Resistant to delamination, water, steam, corrosion, soaps, detergents, and mildew. Does not absorb odors.
      2) Self-lubricating surface that is graffiti resistant to markings from pen, pencil, marker, and paint.
      3) Edges: Machine radius eliminating sharp edges.
      4) Surface texture: Orange peel.
   b. Heat sinks: Attach anti-grip handrail to bottom edges of panels and doors to protect panel from being ignited by vandals.
   c. Nominal Thickness:
      1) Panels: 1 inch.
      2) Doors: 1 inch.
      3) Pilasters: 1 inch.

B. Miscellaneous Construction
   1. Provide factory cut-outs and reinforcing for grab bars and accessories in partitions as required.
   2. Meet Building Code requirements for handicapped access.

PART 3: EXECUTION

3.01 PREPARATION

A. Coordinate requirements for blocking in stud walls to ensure proper support is provided for wall attachments.

B. Coordinate requirements for structural support members and bracing above ceiling for adequate suspension of ceiling hung toilet compartments or attachment of floor to ceiling pilaster.

C. Verify that site conditions are ready to receive work and opening dimensions are as indicated on shop drawings.
D. Verify correct spacing of plumbing fixtures.

### 3.02 INSTALLATION

A. Install partitions secure, plumb, and level in accordance with manufacturer’s instructions.

B. Maintain 3/8 to 1 inch uniform space between wall and panels and between wall and end pilasters.

C. Attach continuous panel brackets securely to walls using tamper proof anchor devices recommended by manufacturer.

D. Where indicated on approved shop drawings, pilasters intersecting adjacent walls shall be terminated 12 inches above floor and attach to wall with continuous brackets.

E. Where indicated on approved shop drawings, pilasters intersecting adjacent walls shall be attached with continuous brackets.

F. Attach panels and pilasters to brackets with tamper-proof sheet metal screws.

G. Brace pilasters with overhead rail. Locate headrail joints at pilaster center lines.

H. Anchor pilaster to floor with stainless steel angle plate, sheet metal screws, and anchors. Conceal floor fastenings with pilaster shoes.

I. For floor to ceiling installations anchor pilaster to floor and to ceiling support with stainless steel angle plate, sheet metal screws, and anchors. Conceal floor and ceiling fastenings with pilaster shoes.

J. Anchor urinal screen panels to walls with continuous aluminum channel.

K. Door installation: Hang doors from pilasters. Equip each door with full length continuous hinge, door latch, door strike and keeper, and coat hook and bumper. Install door pull on out swinging doors.

### 3.03 ERECTION TOLERANCES

A. Maximum variation from true position: ¼ inch.

B. Maximum variation from plumb: 1/8 inch.

### 3.04 ADJUSTING

A. Replace significantly damaged, bent, deeply scratched, or dented panels.

B. Adjust hinges to locate inswinging doors in partial open position and out swinging doors in closed position when unlatched.

C. Adjust and align hardware to uniform clearance at vertical edge of doors.

### 3.05 CLEANING

A. Clean surfaces with liquid spray furniture or counter top polish. Do not use abrasives.

### 3.06 DEMONSTRATION

A. Engage factory-authorized representative to train Owner’s maintenance personnel on cleaning procedures and damage repair. Refer to Section 01 79 00 Demonstration and Training.
END OF SECTION 10 21 13
SECTION 10 28 13
TOILET ACCESSORIES

PART 1: GENERAL

1.01 SUMMARY
A. Section includes:
   1. Toilet accessories where shown on the Drawings and specified herein.

1.02 SUBMITTALS
A. Submit the following in accordance with Section 01 33 00:
   1. Brochure: Submit brochure and schedule of materials indicating quantities of products being provided.

1.03 PRODUCT DELIVERY, STORAGE, AND HANDLING
A. Deliver items in manufacturer's original unopened protective packaging.
B. Store materials in original protective packaging to prevent soiling, physical damage, or wetting.
C. Handle so as to prevent damage to finished surfaces.
D. Protection:
   1. Maintain protective covers on all units until installation is complete.
   2. Remove protective covers at final clean-up of installation.

PART 2: PRODUCTS

2.01 MANUFACTURER
A. The products of Bobrick are specified, comparable products of Bradley are acceptable. All units and trim stainless steel, #4 finish.

2.02 ACCESSORIES
A. Grab Bars (Field verify sizes)
   1. GB #1: B-6806 x 42” horizontal and B-6806 x 18” vertical.
   2. GB #4: B-6806 x 24”.
B. Supplied by Owner, installed by Contractor.
C. Mirrors
   1. MIR #2: 32” wide x 60” tall
      a. Match size of existing mirror in girls’ toilet room, identified for salvaging and reinstallation.
D. Paper Towel Dispenser “PTD” (Surface mounted): Supplied by Owner, installed by Contractor.

E. Coat Hook: B-677

F. Soap Dispensers (SD): Supplied by Owner, installed by Contractor.

G. Keys to Locked Accessories: Manufacturer's standard, keyed alike.

H. Mounting Kits: Provided with each unit shall suit wall construction.

I. Dispensing Accessories: Fully loaded and in operating condition at time of completion.

PART 3: EXECUTION

3.01 INSPECTION

A. Check opening scheduled to receive recessed units for correct dimensions, plumbness of blocking or frames, preparation that would affect installation of accessories.

B. Check areas to receive surface mounted units for conditions that would affect quality and execution of work.

C. Verify spacing of plumbing fixtures and toilet partitions that affect installation of accessories.

D. Coordinate blocking requirements with Section 06 10 53, prior to enclosure of walls.

E. Do not begin installation of washroom accessories until openings and surfaces are acceptable.

3.02 INSTALLATION

A. Drill holes according to manufacturer's mounting templates or printed instructions.

B. Mount recessed accessories into wall openings with wood screws through cabinet side into wood blocking, or sheet metal screws into metal frames.

C. Mount surface mounted accessories to back up with toggle bolts, plumb and align.

D. Anchor grab bars to through-wall anchor plates.

3.03 ADJUST AND CLEAN

A. Adjust accessories for proper operation.

B. After completion of installation, clean and polish all exposed surfaces.

C. Deliver keys and instruction sheets to Owner's Representative.

END OF SECTION 10 28 13
PART 1 - GENERAL

1.01 SUMMARY
A. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Transition fittings.
   3. Dielectric fittings.
   4. Mechanical sleeve seals.
   5. Sleeves.
   7. Grout.
   8. Plumbing demolition.
   9. Equipment installation requirements common to equipment sections.
   10. Painting and finishing.
   11. Concrete bases.
   12. Supports and anchorages.

1.02 DEFINITIONS
A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
F. The following are industry abbreviations for plastic materials:
   1. CPVC: Chlorinated polyvinyl chloride plastic.
   2. PVC: Polyvinyl chloride plastic.
G. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

1.03 SUBMITTALS
A. Product Data: For the following:
1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

1.04 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.

1.05 COORDINATION
A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing 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 plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.01 MANUFACTURERS
A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPE, TUBE, AND FITTINGS
A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS
A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
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 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 thick, unless otherwise indicated; and 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. Solvent Cements for Joining Plastic Piping:
1. CPVC Piping: ASTM F 493.
2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.04 TRANSITION FITTINGS
A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
   1. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
   2. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
   3. Aboveground Pressure Piping: Pipe fitting.
B. Plastic-to-Metal Transition Fittings: CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC or PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.05 DIELECTRIC FITTINGS
A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
B. Insulating Material: Suitable for system fluid, pressure, and temperature.
C. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
D. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
   1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.06 ESCUTCHEONS
A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
B. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
C. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
D. One-Piece, Floor-Plate Type: Cast-iron floor plate.
E. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.
3.01 PLUMBING DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
   3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, stamped sheet with polished chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type with spring clips.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.

f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw or spring clips.

g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.

h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

2. Existing Piping: Use the following:


b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.

c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.

d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.

e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge and set screw or spring clips.

f. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.

g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.
   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
   a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
   b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
   c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

   1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

R. Verify final equipment locations for roughing-in.

S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.03 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   4. PVC Nonpressure Piping: Join according to ASTM D 2855.

F. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

G. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End Pipe and Fittings: Use butt fusion.
   2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.04 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
   3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.05 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.
3.06  ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.

B. 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.

C. Attach to substrates as required to support applied loads.
END OF SECTION 22 05 00
PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Bronze ball valves.
   2. Iron, single-flange butterfly valves.
   4. Bronze lift check valves.
   5. Bronze swing check valves.
   8. Bronze gate valves.
  11. Iron globe valves.
  12. Chainwheels.

1.02 DEFINITIONS

A. CWP: Cold working pressure.
B. EPDM: Ethylene propylene copolymer rubber.
C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
D. NRS: Nonrising stem.
E. OS&Y: Outside screw and yoke.
F. RS: Rising stem.
G. SWP: Steam working pressure.

1.03 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.04 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
B. ASME Compliance:
   1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   2. ASME B31.1 for power piping valves.
   3. ASME B31.9 for building services piping valves.
C. NSF Compliance: NSF 61 and 372 for lead valve materials for potable-water service.
1.05 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set angle, gate, and globe valves closed to prevent rattling.
   4. Set ball and plug valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

A. Refer to 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. Handlever: For quarter-turn valves NPS 6 and smaller.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
   1. 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.

F. Valve-End Connections:
   1. Solder Joint: With sockets according to ASME B16.18.
   2. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Crane Co.; Crane Valve Group; Crane Valves.
      c. Hammond Valve.
      d. Milwaukee Valve Company.
      e. NIBCO INC.
      f. Kitz Corporation
   2. Description:
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full for 2” and smaller, regular port for 2-1/2” and larger.

PART 3 - EXECUTION

3.01 EXAMINATION
A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION
A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

3.03 ADJUSTING
A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS
A. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball valves.
   2. Throttling Service: Globe or butterfly valves.

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.
3.05 DOMESTIC, HOT- AND COLD-WATER LEAD FREE VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 125, bronze disc.
3. Ball Valves: One piece, full port, bronze with bronze trim.

END OF SECTION 22 05 23
1.01 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. Metal framing systems.
   4. Thermal-hanger shield inserts.
   5. Fastener systems.
   6. Pipe stands.
   7. Pipe positioning systems.
   8. Equipment supports.

1.02 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."

1.03 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].

1.04 SUBMITTALS
A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Fiberglass pipe hangers.
   3. Thermal-hanger shield inserts.
   4. Pipe positioning systems.
B. Welding certificates.
PART 2 - PRODUCTS

2.01 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.

2.02 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. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

D. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.03 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.

2.04 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:

   1. Carpenter & Paterson, Inc.
   2. ERICO/Michigan Hanger Co.
   3. PHS Industries, Inc.
   4. Pipe Shields, Inc.
   5. Rilco Manufacturing Company, Inc.
   6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.
2.05 FASTENER SYSTEMS

A. 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:
      b. Empire Industries, Inc.
      c. Hilti, Inc.
      d. ITW Ramset/Red Head.
      e. MKT Fastening, LLC.
      f. Powers Fasteners.

2.06 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:

   2. HOLDRITE Corp.; Hubbard Enterprises.
   3. Samco Stamping, Inc.

2.07 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

PART 3 - EXECUTION

3.01 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.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
7. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
8. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
9. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
10. 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.
11. 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.
12. 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.
13. 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.
14. 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.

G. 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.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. 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.

J. 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.

K. 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 test, 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.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.02 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. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:
   1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:
   1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
   2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.

G. 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.

H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.


J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

M. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
O. 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.

5. Insert Material: Length at least as long as protective shield.

6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.03 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

3.04 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods.
PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Equipment labels.
   2. Pipe labels.

1.02 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.

1.03 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
B. Coordinate installation of identifying devices with locations of access panels and doors.
C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

PART 3 - EXECUTION

3.01 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09.
B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   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 25 feet along each run.

C. Pipe Label Color Schedule:
   1. Domestic Cold Water Piping:
      a. Background Color: Green.
      c. Pipe Label: CW
   2. Domestic Hot Water Piping:
      a. Background Color: Green.
      c. Pipe Label: HW
   3. Domestic Hot Water Circulation Piping:
      a. Background Color: Green.
      c. Pipe Label: HWC

D. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 25 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.03 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.
PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Insulation Materials:
   a. Mineral fiber.

2. Insulating cements.

3. Adhesives.


5. Lagging adhesives.


7. Factory-applied jackets.

8. Tapes.


10. Corner angles.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Sustainable Design Submittals:
   
   Product Data: For adhesives, mastics, and sealants, indicating VOC content.

   2. Laboratory Test Reports: For adhesives, mastics, and sealants, indicating compliance with requirements for low-emitting materials.

C. Qualification Data: For qualified Installer.

D. Field quality-control reports.

1.03 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.
1.04 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.

1.05 COORDINATION
A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "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 Coordination 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.

1.06 SCHEDULING
A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS
2.01 INSULATION MATERIALS
A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
F. Mineral-Fiber, Preformed Pipe Insulation:
   1. Products: Subject to compliance with requirements, provide one of the following:
      b. Knauf Insulation.
      c. Manson Insulation Inc.
      d. Owens Corning.
   1. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL.
   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.

2.02 INSULATING CEMENTS
B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
2.03 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less.

2. **Adhesives and sealants shall comply** with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less.

2. **Adhesives and sealants shall comply** with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."


1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less.

2. **Adhesives and sealants shall comply** with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.04 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less.

2. **Mastics shall comply with the** testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.

2. Service Temperature Range: Minus 20 to plus 180 deg F.


C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.

2. Service Temperature Range: 0 to 180 deg F.


D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.

2. Service Temperature Range: Minus 50 to plus 220 deg F.

3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.

E.  Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
   1. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
   2. Service Temperature Range: Minus 20 to plus 200 deg F.
   3. Solids Content: 63 percent by volume and 73 percent by weight.

2.05 LAGGING ADHESIVES
A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
   1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. 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 deg F.

2.06 SEALANTS
A. Joint Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Permanently flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 100 to plus 300 deg F.
   4. Color: White or gray
   5. Sealant shall have a VOC content of 420 g/L or less.
   
   Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. FSK and Metal Jacket Flashing Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F.
   5. Sealant shall have a VOC content of 420 g/L or less.
   6. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.07 FIELD-APPLIED FABRIC-REINFORCING MESH
A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.
C. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for equipment and pipe.

2.08 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Width: 3 inches.
   2. Thickness: 11.5 mils.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Width: 3 inches.
   2. Film Thickness: 6.5 mils.

2.09 SECUREMENTS

A. Bands:
   1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
   2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.

B. Insulation Pins and Hangers:
   1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
   2. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
      a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
      b. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
      c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
   3. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
      a. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
      b. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
      c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
   b. Adhesive-backed base with a peel-off protective cover.

5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

   a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

6. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel or 0.062-inch soft-annealed, galvanized steel.

2.10 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

PART 3 - EXECUTION

3.01 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.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

   1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
   2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03  GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of 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. Staple laps with outward clinching staples along edge at 2 inches o.c.
   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.
   5. Handholes.
   6. Cleanouts.

3.04 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
   1. Comply with requirements in Division 07 Section "Penetration Firestopping" and fire-resistant 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 Division 07 Section "Penetration Firestopping."

3.05 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. 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.

3.06 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.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.

3.07 FIELD QUALITY CONTROL
A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
B. Perform tests and inspections.
C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.08 PIPING INSULATION SCHEDULE, GENERAL
A. Items Not Insulated: Unless otherwise indicated, do not install insulation one 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.

3.09 INDOOR PIPING INSULATION SCHEDULE
A. Domestic Cold Water, NPS 1 and smaller:
   1. Mineral-fiber, preformed pipe insulation: 1/2 inch.
B. Domestic Hot and Recirculated Hot Water 140 degrees F and below, NPS 1-1/4 and smaller:
   1. Mineral-fiber, preformed pipe insulation: 1 inch.
C. Domestic Hot and Recirculated Hot Water 141 degrees F and above, NPS 1-1/4 and smaller:

END OF SECTION 22 07 00
PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
   2. Encasement for piping.
   4. Flexible connectors.
   5. Water meters furnished by utility company for installation by Contractor.
   6. Wall penetration systems.

1.02 SUBMITTALS

A. Product Data: For the following products:
   1. Specialty valves.
   2. Flexible connectors.
   3. Backflow preventers and vacuum breakers.
   4. Sleeves and sleeve seals.
   5. Water penetration systems.


C. Field quality-control reports.

1.03 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. All materials shall meet 25/50 flame spread/smoke developed when tested in accordance with ASTM E 84.

C. Comply with NSF 61 for potable domestic water piping, DZR and lead-free components.

1.04 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 Owner no fewer than two days in advance of proposed interruption of water service.
   2. Do not proceed with interruption of water service without Owner's written permission.

1.05 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.
PART 2 - PRODUCTS

2.01 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.02 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
   4. 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. Copper Pressure-Seal-Joint Fittings:
   1. Fittings for NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
   2. Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

C. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.

2.03 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.

2.04 TRANSITION FITTINGS

A. General Requirements:
   1. Same size as pipes to be joined.
   2. Pressure rating at least equal to pipes to be joined.
   3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.
D. Plastic-to-Metal Transition Fittings:
   1. Description:
      a. CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
      b. One end with threaded DZR brass insert and one solvent-cement-socket or threaded end.

PART 3 - EXECUTION

3.01 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 domestic water piping level without pitch and plumb.

D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

G. Install piping adjacent to equipment and specialties to allow service and maintenance.

H. Install piping to permit valve servicing.

I. 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.

J. Install piping free of sags and bends.

K. Install fittings for changes in direction and branch connections.

L. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

M. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.

3.02 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. 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."

E. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.03 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

B. 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 Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.04 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:
   1. NPS 1-1/2 and Smaller: Fitting-type coupling.
   2. NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings.

3.05 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings.

3.06 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "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.
   3. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-3/4: 60 inches with 3/8-inch rod.
   2. NPS 1 and NPS 1 1/4: 72 inches with 3/8-inch rod.
   3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.07 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. 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.

3.08 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
B. Label pressure piping with system operating pressure.

3.09 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.

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
   a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide 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.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill and isolate system according to either of the following:
      1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
   c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
   d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
3.12 **PIPING SCHEDULE**

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Above Ground Domestic Water Piping, NPS 2 and Smaller:
   1. Hard Copper Tube, ASTM B 88, Type L; Cast- or wrought-copper solder-joint fittings; soldered joints. Copper pressure-seal-joint fittings; and pressure-sealed joints.

3.13 **VALVE SCHEDULE**

A. Use check valves to maintain correct direction of domestic water flow to and from equipment.
END OF SECTION 22 11 16
PART 1 - GENERAL

1.01 SUMMARY
A. This Section includes the following domestic water piping specialties:
   2. Temperature-actuated water mixing valves.
   3. Water hammer arresters.

1.02 PERFORMANCE REQUIREMENTS
A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.03 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.

1.04 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:
   2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9." All components in direct contact with potable water shall be DZR and lead free.

PART 2 - PRODUCTS

2.01 BALANCING VALVES
A. Memory-Stop Balancing Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Conbraco Industries, Inc.
      b. Crane Co.; Crane Valve Group; Crane Valves.
      c. Crane Co.; Crane Valve Group; Jenkins Valves.
      d. Crane Co.; Crane Valve Group; Stockham Div.
      e. Hammond Valve.
      f. Milwaukee Valve Company.
      g. NIBCO INC.
      h. Red-White Valve Corp.
   2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.

4. Size: NPS 2 or smaller.

5. Body: Copper alloy.

6. Port: Standard or full port.

7. Ball: Chrome-plated brass.

8. Seats and Seals: Replaceable.

9. End Connections: Solder joint or threaded.


2.02 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.
   b. Honeywell Water Controls.
   c. Lawler Manufacturing Company, Inc.
   d. Leonard Valve Company.
   e. Powers; a Watts Industries Co.
   g. Zurn Plumbing Products Group; Wilkins Div.
   h. Bradley

2.03 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AMTROL, Inc.
   b. Josam Company.
   c. MIFAB, Inc.
   d. PPP Inc.
   e. Sioux Chief Manufacturing Company, Inc.
   g. Tyler Pipe; Wade Div.
   h. Watts Drainage Products Inc.
   i. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Description: Refer to schedule on plans.
PART 3 - EXECUTION

3.01 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install balancing valves in locations where they can easily be adjusted.

C. 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.

D. Install water hammer arresters in water piping according to PDI-WH 201.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.03 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Calibrated balancing valves.

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 Division 22 Section "Identification for Plumbing Piping and Equipment."

3.04 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 11 23
DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. In-line, seal-less centrifugal pumps.

1.2 DEFINITIONS
A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.3 SUBMITTALS
A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.
B. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

1.4 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Retain shipping flange protective covers and protective coatings during storage.
B. Protect bearings and couplings against damage.
C. Comply with pump manufacturer's written rigging instructions for handling.

1.6 COORDINATION
A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 IN-LINE, SEAL-LESS CENTRIFUGAL PUMPS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Armstrong Pumps Inc.
   2. Bell & Gossett Domestic Pump; Xylem Inc.
   3. Grundfos Pumps Corp.
   4. TACO Incorporated.
   5. WILO USA LLC - WILO Canada Inc.
B. Description: Factory-assembled and -tested, in-line, close-coupled, pumps. All components in direct contact with potable water shall be DZR and lead free.
C. Pump Construction:
   1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
2. Casing: Bronze or stainless steel, with threaded or companion-flange connections.
4. Motor: ECM/PM, unless otherwise indicated.

2.2 CONTROLS
A. Timers: Electric, for control of hot-water circulation pump.
   1. Type: Programmable, seven-day clock with manual override on-off switch.
   2. Enclosure: NEMA 250, Type 1, suitable for wall or pump mounting.
   3. Operation of Pump: On or off.
   4. Transformer: Provide if required.
   5. Programmable Sequence of Operation: Up to two on-off cycles each day for seven days.

2.3 MOTORS
A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
   2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

PART 3 - EXECUTION
3.1 EXAMINATION
A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION
A. Comply with HI 1.4.
B. Install in-line, seal-less centrifugal pumps with shaft horizontal unless otherwise indicated.
C. Install continuous-thread hanger rods and spring hangers with vertical-limit stop of size required to support pump weight.
   1. Comply with requirements for vibration isolation devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.
   2. Comply with requirements for hangers and supports specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
D. Install pressure/temperature test ports on the suction and discharge piping for all domestic water pumps.
E. Install pressure switches in water supply piping.
F. Install thermostats in hot-water return piping.
G. Install timers as shown on the plans.
H. Install time-delay relays in piping between water heaters and hot-water storage tanks.

3.3 CONNECTIONS
A. Comply with requirements for piping specified in Division 22 Section "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
   1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
      a. Comply with requirements for flexible connectors specified in Division 22 Section "Domestic Water Piping."
   2. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping" and comply with requirements for strainers specified in Division 22 Section "Domestic Water Piping Specialties."
   3. Install pressure gauge at suction of each pump and pressure gauge at discharge of each pump. Install at integral pressure-gauge tappings where provided or install pressure-gauge connectors in suction and discharge piping around pumps. Comply with requirements for pressure gauges and snubbers specified in Division 22 Section "Meters and Gages for Plumbing Piping."

D. Comply with Division 26 Sections for electrical connections and wiring methods.

E. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

3.4 IDENTIFICATION

A. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.5 STARTUP SERVICE

A. Perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Check piping connections for tightness.
   3. Clean strainers on suction piping.
   4. Perform the following startup checks for each pump before starting:
      a. Verify bearing lubrication.
      b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
      c. Verify that pump is rotating in the correct direction.
   5. Prime pump by opening suction valves and closing drains and prepare pump for operation.
   7. Open discharge valve slowly.
   8. Adjust temperature settings on thermostats.

3.6 ADJUSTING

A. Adjust domestic water pumps to function smoothly and lubricate as recommended by manufacturer.
B. Adjust initial temperature set points.
C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
END OF SECTION 22 11 23
PART 1 - GENERAL

1.01 SUMMARY
A. This Section includes the following for soil, waste, and vent piping inside the building:
   1. Pipe, tube, and fittings.
   2. Special pipe fittings.
   3. Encasement for underground metal piping.

1.02 DEFINITIONS
A. EPDM: Ethylene-propylene-diene terpolymer rubber.
B. LLDPE: Linear, low-density polyethylene plastic.
C. NBR: Acrylonitrile-butadiene rubber.
D. PE: Polyethylene plastic.
E. PVC: Polyvinyl chloride plastic.
F. TPE: Thermoplastic elastomer.

1.03 PERFORMANCE REQUIREMENTS
A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1.04 SUBMITTALS
A. Product Data: For pipe, tube, fittings, and couplings.
B. Field quality-control inspection and test reports.

1.05 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.

PART 2 - PRODUCTS

2.01 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.

2.02 PIPING MATERIALS
A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.
2.03 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.

C. 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) Fernco, Inc.
      3) Ideal Div.; Stant Corp.
      4) Mission Rubber Co.
      5) Tyler Pipe; Soil Pipe Div.

2.04 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

B. Solvent Cement and Adhesive Primer:

1. Use PVC solvent cement that has a VOC content of 510 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).

2.05 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure 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:
   b. Fernco, Inc.
   c. Logan Clay Products Company (The).
   d. Mission Rubber Co.
   e. NDS, Inc.
   f. Plastic Oddities, Inc.

2. Sleeve Materials:
   b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
   c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
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:
   b. Mission Rubber Co.

PART 3 - EXECUTION

3.01 EXCAVATION

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.02 PIPING APPLICATIONS

A. Below Ground Soil, Waste and Vent Piping, All sizes:
   1. Solid wall schedule 40 PVC pipe, PVC socket fittings, and solvent-cemented joints.

B. Above Ground Soil, Waste and Vent Piping, NPS 4 and smaller:
   1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and coupled joints.

3.03 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

D. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

E. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.

F. 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.

G. 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.

H. 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.

I. 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 for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.

   2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.

   3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

K. Install underground PVC soil and waste drainage piping according to ASTM D 2321.

L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.04  JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.05  HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 22 Section "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.

3. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

E. 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.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.06  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.

3.07 FIELD QUALITY CONTROL
A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary 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.

3.08 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.

3.09 PROTECTION
A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.
PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes the following electric water heaters:
   1. Household, small-capacity electric water heaters.
   2. Light-commercial electric water heaters.
   3. Compression tanks.

1.2 SUBMITTALS
A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
B. Sustainable Design Submittals:
   Product Data: For energy efficiency.
C. Shop Drawings: Diagram power, signal, and control wiring.
D. Product Certificates: For each type of electric water heater, signed by product manufacturer.
E. Source quality-control test reports.
F. Field quality-control test reports.
G. Operation and Maintenance Data: For electric water heaters to include in emergency, operation, and maintenance manuals.
H. Warranty: Special warranty specified in this Section.

1.3 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 Division 01 Section "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 Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
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 1.
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. All components in contact with potable water shall be DZR and lead free.

1.4 COORDINATION
A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

1.5 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. Electric Water Heaters:
      1) Storage Tank: three years.
      2) Controls and Other Components: one year.
   b. Compression Tanks: One year.

**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 LIGHT-COMMERCIAL ELECTRIC WATER HEATERS**

A. Description: Comply with UL 174 for household, storage electric water heaters.

1. Manufacturers:
   d. Smith, A. O. Water Products Company.
   e. State Industries, Inc.

2. Storage-Tank Construction: Steel with corrosion-resistant coating.
   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.
   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.

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. Flexcon Industries.
   c. Smith, A. O.; Aqua-Air Div.
   d. State Industries, Inc.
   e. Taco, Inc.
   f. Watts Regulator Co.
   g. Wessels Co.

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.

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.

H. Water Regulators: ASSE 1003, water-pressure reducing valve. Set at 25-psig- maximum outlet pressure, unless otherwise indicated.

I. 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 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 Division 22 Section "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 combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install 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 Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.

E. Install a thermometer on outlet pipe and a pressure/temperature test port on the inlet pipe of each water heater.

1. If the water heater has a digital readout of the discharge water temperature, then install a pressure/temperature test port on the discharge pipe in lieu of the thermometer.

F. Install water regulator, with integral bypass relief valve, in booster-heater inlet piping and water hammer arrester in booster-heater outlet piping.

G. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.

H. Fill water heaters with water.

I. 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 Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
3.3 **FIELD QUALITY CONTROL**

A. 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.

B. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 **DEMONSTRATION**

A. Train Owner's maintenance personnel to adjust, operate, and maintain electric water heaters. Refer to Division 01 Section "Demonstration and Training."
END OF SECTION 22 33 00
PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following conventional plumbing fixtures and related components:

1. Faucets.
2. Commercial sinks.

1.03 DEFINITIONS

A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

B. 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.

1.04 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. Sustainable Design Submittals: Product Data: For water consumption.

C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.


D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water. All components in contact with wetted surfaces shall be DZR and lead free.

E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

F. Comply with the following applicable standards and other requirements specified for sink faucets:

1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.

G. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
   2. Brass and Copper Supplies: ASME A112.18.1.

H. Comply with the following applicable standards and other requirements specified for miscellaneous components:

PART 2 - PRODUCTS

2.01 SINK FAUCETS
   A. Sink Faucets:
      1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         a. Chicago Faucets.
         b. Delta Faucet Company.
         c. Elkay Manufacturing Co.
         d. Kohler Co.
         e. Moen, Inc.
         f. Zurn Plumbing Products Group; Commercial Brass Operation.

2.02 PROTECTIVE SHIELDING GUARDS
   A. Protective Shielding Pipe Covers:
      1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         a. Engineered Brass Co.
         b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
         c. McGuire Manufacturing Co., Inc.
         d. Plumberex Specialty Products Inc.
         e. TCI Products.
         f. TRUEBRO, Inc.
         g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
      2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
2.03 COMMERCIAL SINKS

A. Commercial Sinks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Advance Tabco.
   b. Elkay Manufacturing Co.
   c. Just Manufacturing Company.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before 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.

3.02 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

C. Install counter-mounting fixtures in and attached to casework.

D. Install fixtures level and plumb according to roughing-in drawings.

E. 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 Division 22 Section "General-Duty Valves for Plumbing Piping."

F. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

G. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

H. 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.

I. 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.

J. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.

2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

K. 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 Division 22 Section "Common Work Results for Plumbing."

L. 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 Division 07 Section "Joint Sealants."
3.03 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.

3.04 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.

3.05 ADJUSTING
A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
B. Adjust water pressure at faucets to produce proper flow and stream.
C. Replace washers and seals of leaking and dripping faucets and stops.

3.06 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.

3.07 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 23 05 00
COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
7. Grout.
8. HVAC demolition.
9. Equipment installation requirements common to equipment sections.
10. Painting and finishing.
11. Concrete bases.
12. Supports and anchorages.

1.2 DEFINITIONS

A. Finished Spaces:  Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.

B. Exposed, Interior Installations:  Exposed to view indoors.  Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations:  Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.  Examples include rooftop locations.

D. Concealed, Interior Installations:  Concealed from view and protected from physical contact by building occupants.  Examples include above ceilings and chases.

E. Concealed, Exterior Installations:  Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures.  Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.
1.3 **SUBMITTALS**

A. **Product Data:** For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

B. **Welding certificates.**

1.4 **QUALITY ASSURANCE**

A. **Steel Support Welding:** Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. **Steel Pipe Welding:** Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. **Electrical Characteristics for HVAC Equipment:** Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 **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.

1.6 **COORDINATION**

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC 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 HVAC items requiring access that are concealed behind finished surfaces.

**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. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 **PIPE, TUBE, AND FITTINGS**

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.
2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

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 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 thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

D. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
   1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.5 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

   1. Manufacturers:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Metraflex Co.
      d. Pipeline Seal and Insulator, Inc.

   2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

   3. Pressure Plates: Glass reinforced plastic. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.6 SLEEVES
A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with set screws.
E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.7 ESCUTCHEONS
A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
C. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
D. One-Piece, Floor-Plate Type: Cast-iron floor plate.
E. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.8 GROUT
A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION
3.1 HVAC DEMOLITION
A. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
   3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
   4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
   5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
6. **Equipment to Be Removed and Reinstalled:** Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

7. **Equipment to Be Removed and Salvaged:** Disconnect and cap services and remove equipment and deliver to Owner.

B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

### 3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

**A.** Install piping according to the following requirements and Division 23 Sections specifying piping systems.

**B.** Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

**C.** Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

**D.** Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

**E.** Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

**F.** Install piping to permit valve servicing.

**G.** Install piping at indicated slopes.

**H.** Install piping free of sags and bends.

**I.** Install fittings for changes in direction and branch connections.

**J.** Install piping to allow application of insulation.

**K.** Select system components with pressure rating equal to or greater than system operating pressure.

**L.** Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. **New Piping:**
   - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
   - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
   - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
   - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
   - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
   - f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw or spring clips.
   - g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
   - h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

2. **Existing Piping:** Use the following:
   - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
   - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.

d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.

e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge and set screw or spring clips.

f. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.

g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.
   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

   Steel Pipe Sleeves: For pipes smaller than NPS 6.
   a. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
   b. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.

   1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.

2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in...
annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.


F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
   3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING
A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 CONCRETE BASES
A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
   1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03.

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES
A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

3.9 ERECTION OF WOOD SUPPORTS AND ANCHORAGES
A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

B. 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.

C. Attach to substrates as required to support applied loads.

3.10 GROUTING
A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.
H. Cure placed grout.
SECTION 23 05 13
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at 40 deg C and at altitude of 3300 feet above sea level and rated for operation up to 6600 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Rotor: Random-wound, squirrel cage.

E. Bearings: Permanently lubricated ball bearings up through 5 HP. Regreaseable, shielded, antifriction ball bearings suitable for radial and thrust loading for motors over 5 HP.

F. Temperature Rise: Class B.

G. Insulation: Class F.

H. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

I. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Variable Frequency Controllers:
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
   2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
   3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
   4. Thermal Protection: Comply with NEMA MG 1 for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Split phase.
   3. Capacitor start, inductor run.
   4. Capacitor start, capacitor run.

B. Bearings: Prelubricated, ball bearings or sleeve bearings suitable for radial and thrust loading.

C. Motors 1/20 HP and Smaller: Shaded-pole type.

D. Thermal Protection: Internal protection to automatically open motor power supply circuit when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 23 05 13
SECTION 23 05 29
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes the following hangers and supports for HVAC system piping and equipment:
   1. Steel pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Thermal-hanger shield inserts.
   5. Fastener systems.
   6. Pipe stands.
   7. Equipment supports.

1.2 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."

1.3 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.

1.4 SUBMITTALS
A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Fiberglass pipe hangers.
   3. Thermal-hanger shield inserts.
B. Welding certificates.

1.5 QUALITY ASSURANCE
A. Welding: Qualify procedures and personnel according to the following:
   1. AWS D1.1, "Structural Welding Code--Steel."
   4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
   5. 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, provide products by one of the manufacturers specified.

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:

1. AAA Technology & Specialties Co., Inc.
2. Bergen-Power Pipe Supports.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. 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.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
5. Thomas & Betts Corporation.
6. Toleco Inc.
7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Manufacturers:
2. Champion Fiberglass, Inc.
3. Cope, T. J., Inc.; Tyco International Ltd.
4. Seasafe, Inc.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig minimum, compressive-strength insulation insert encased in sheet metal shield.
B. Manufacturers:
1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. 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:
b. Empire Industries, Inc.
c. Hilti, Inc.
d. ITW Ramset/Red Head.
e. MKT Fastening, LLC.
f. Powers Fasteners

2.7 PIPE STAND FABRICATION
A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
   2. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
   3. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
   1. Bases: One or more plastic.
   2. Vertical Members: Two or more protective-coated-steel channels.
   3. Horizontal Member: Protective-coated-steel channel.
F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.8 EQUIPMENT SUPPORTS
A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.9 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.
   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.
F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system
Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated
stationary pipes, NPS 1/2 to NPS 30.

2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16,
requiring up to 4 inches of insulation.

3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to
NPS 24, requiring clamp flexibility and up to 4 inches of insulation.

4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or
no insulation is required.

5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure
for hanger installation before pipe erection.

6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated
stationary pipes, NPS 3/4 to NPS 8.

7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes,
NPS 1/2 to NPS 8.

8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to
NPS 8.

9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary
pipes, NPS 1/2 to NPS 2.

10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of
noninsulated stationary pipes, NPS 3/8 to NPS 8.

11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated
stationary pipes, NPS 3/8 to NPS 3.

12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.

13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base
stanchion support and cast-iron floor flange.

15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base
stanchion support and cast-iron floor flange and with U-bolt to retain pipe.

16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to
NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor
flange.

17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if
longitudinal movement caused by expansion and contraction might occur.

18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from
single rod if horizontal movement caused by expansion and contraction might occur.

19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal
movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal
movement caused by expansion and contraction might occur and vertical adjustment is not necessary.

21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if
vertical and lateral adjustment during installation might be required in addition to expansion and
contraction.
G. 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.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. 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.
J. 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.

K. 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.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

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 mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

H. Pipe Stand Installation:
   1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
   2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.

I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.


K. Install hangers and supports to allow controlled thermal 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 B31.1 (for power piping) and 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 B31.1 for power piping and ASME B31.9 for building services piping.
   2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood 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.
   C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Equipment labels.
   2. Warning signs and labels.
   3. Duct labels.
   4. Pipe labels.
   5. Valve tags.
   6. Warning tags.

1.2 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 to match school’s existing system.
E. Valve Schedules: For each piping system to include in maintenance manuals.

1.3 COORDINATION
A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
B. Coordinate installation of identifying devices with locations of access panels and doors.
C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS
A. Metal Labels for Equipment:
   1. Material and Thickness: anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   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, 1/8 inch thick, and having predrilled holes for attachment hardware.

2. Letter Color: Black.


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.


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.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

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.


H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 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, 1-1/2” round, 0.032-inch minimum thickness, predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass beaded chain and 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.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
   1. Size: Approximately 4 by 7 inches.
   2. Fasteners: Brass grommet and wire.
   3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

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. Install labels for each major item of mechanical equipment on the T bar ceiling grid for mechanical equipment located above the ceiling. This label is in addition to the label required in part A.

C. Locate equipment labels where accessible and visible.

D. Label equipment as tagged on the schedules or per the Owner’s equipment labeling system.

3.3 PIPE LABEL INSTALLATION

A. 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 25 feet along each run.
B. Pipe Label Color Schedule:
   1. Heating Water Piping:
      a. Background Color: Green.
      c. Pipe Label: HWS / HWR
   2. Refrigerant Piping:
      a. Background Color: Yellow.
      b. Letter Color: Black.
      c. Pipe Label: RS / RL

C. 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 HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

D. 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: 1-1/2"
      a. Heating Water: (BLDG.)-HWV-##.

3.4 WARNING-TAG INSTALLATION
   A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 23 05 53
PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Balancing Air Systems:
      a. Constant-volume air systems.
      b. Variable-air-volume systems.
   2. Balancing Hydronic Piping Systems:
      a. Constant-flow hydronic systems.
      b. Variable-flow hydronic systems.

1.02 DEFINITIONS

C. TAB: Testing, adjusting, and balancing.
D. TABB: Testing, Adjusting, and Balancing Bureau.
E. TAB Specialist: An entity engaged to perform TAB Work.

1.03 SUBMITTALS

A. Qualification Data: Within 15 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
D. Certified TAB reports.
E. Sample report forms.
F. Instrument calibration reports, to include the following:
   1. Instrument type and make.
   2. Serial number.
   3. Application.
   4. Dates of use.
   5. Dates of calibration.

1.04 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC NEBB or TABB.
   1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC NEBB or TABB.
2. **TAB Technician:** Employee of the TAB contractor and who is certified by AABC NEBB or TABB as a TAB technician.

B. **TAB Conference:** Meet with Construction Manager and Commissioning Authority on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.

1. **Agenda Items:**
   b. The TAB plan.
   c. Coordination and cooperation of trades and subcontractors.
   d. Coordination of documentation and communication flow.

C. Certify TAB field data reports and perform the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. **TAB Report Forms:** Use standard TAB contractor's forms approved by Construction Manager or Commissioning Authority.

E. **Instrumentation Type, Quantity, Accuracy, and Calibration:** As described in ASHRAE 111, Section 5, "Instrumentation."

1.05 **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.

1.06 **COORDINATION**

A. **Notice:** Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. **Perform TAB after leakage and pressure tests have been satisfactorily completed.**

**PART 2 - PRODUCTS (Not Applicable)**

**PART 3 - EXECUTION**

3.01 **TAB SPECIALISTS**

A. Subject to compliance with requirements, engage one of the following:
   1. Checkpoint.
   2. Finn & Associates.
   3. TAB Services.
   5. JPG Engineering.

3.02 **EXAMINATION**

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
B. Examine 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.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.
   1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
   2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units; such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.03 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.

3.04 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" ASHRAE 111 NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" SMACNA's and/or "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.


B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.05 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

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."

3.06 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.
a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:
   a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
   b. Measure static pressure directly at the fan outlet or through the flexible connection.
   c. 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.
   d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
   a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.

5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

6. Obtain approval from Construction Manager or Commissioning Authority for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.

7. 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.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
   1. Measure airflow of submain and branch ducts.
      a. 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.
   2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
   3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.
   1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. 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.
   1. 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.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.07 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.

2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.

3. Measure total system airflow. Adjust to within indicated airflow.

4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.

5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
   a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
   a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.

8. Record final fan-performance data.

C. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.

3. Set terminal units at full-airflow condition.

4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.

5. Adjust terminal units for minimum airflow.
6. Measure static pressure at the sensor.
7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.08 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
   1. Open all manual valves for maximum flow.
   2. Check liquid level in expansion tank.
   3. Check makeup water-station pressure gage for adequate pressure for highest vent.
   4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
   5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
   6. Set system controls so automatic valves are wide open to heat exchangers.
   7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

3.09 PROCEDURES FOR CONSTANT-FLOW HYDRONIC 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.
      a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Construction Manager or Commissioning Authority and comply with requirements in Division 23 Section "Hydronic Pumps."
   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.
      a. Monitor motor performance during procedures and do not operate motors in overload conditions.
   3. 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.
   4. 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.

3.10 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS
A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.11 PROCEDURES FOR MOTORS
A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.12 PROCEDURES FOR BOILERS
A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

B. Steam Boilers: Measure and record entering-water temperature and flow and leaving-steam pressure, temperature, and flow.

3.13 PROCEDURES FOR HEAT-TRANSFER COILS
A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:
   1. Nameplate data.
   2. Airflow.
   3. Entering- and leaving-air temperature at full load.
   4. Voltage and amperage input of each phase at full load and at each incremental stage.
   5. Calculated kilowatt at full load.
   6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each refrigerant coil:
   1. Dry-bulb temperature of entering and leaving air.
   2. Wet-bulb temperature of entering and leaving air.
   3. Airflow.
   4. Air pressure drop.
   5. Refrigerant suction pressure and temperature.

3.14 TOLERANCES
A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans and Equipment with Fans:  Plus or minus 10 percent.
   2. Air Outlets and Inlets:  Plus or minus 10 percent.
   3. Heating-Water Flow Rate:  Plus or minus 10 percent.
   4. Cooling-Water Flow Rate:  Plus or minus 10 percent.

3.15 REPORTING
A. Initial Construction-Phase Report:  Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports:  Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.16 FINAL REPORT
A. General:  Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
   1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
   2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents:  In addition to certified field-report data, include the following:
1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
   a. Indicated versus final performance.
   b. Notable characteristics of systems.
   c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
   a. Settings for outdoor-, return-, and exhaust-air dampers.
   b. Conditions of filters.
   c. Cooling coil, wet- and dry-bulb conditions.
   d. Face and bypass damper settings at coils.
   e. Fan drive settings including settings and percentage of maximum pitch diameter.
   f. Inlet vane settings for variable-air-volume systems.
   g. Settings for supply-air, static-pressure controller.
   h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:
   a. Unit identification.
   b. Location.
   c. Make and type.
   d. Model number and unit size.
   e. Manufacturer's serial number.
   f. Unit arrangement and class.
   g. Discharge arrangement.
   h. Sheave make, size in inches, and bore.
   i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
   j. Number, make, and size of belts.
   k. Number, type, and size of filters.

2. Motor Data:
   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):
   a. Total air flow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Filter static-pressure differential in inches wg.
   f. Preheat-coil static-pressure differential in inches wg.
   g. Cooling-coil static-pressure differential in inches wg.
   h. Heating-coil static-pressure differential in inches wg.
   i. Outdoor airflow in cfm.
j. Return airflow in cfm.
k. Outdoor-air damper position.
l. Return-air damper position.
m. Vortex damper position.

F. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:
   a. System identification.
   b. Location.
   c. Make and type.
   d. Model number and size.
   e. Manufacturer's serial number.
   f. Arrangement and class.
   g. Sheave make, size in inches, and bore.
   h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:
   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
   g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):
   a. Total airflow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Suction static pressure in inches wg.

G. Air-Terminal-Device Reports:

1. Unit Data:
   a. System and air-handling unit identification.
   b. Location and zone.
   c. Apparatus used for test.
   d. Area served.
   e. Make.
   f. Number from system diagram.
g. Type and model number.

h. Size.

i. Effective area in sq. ft.

2. Test Data (Indicated and Actual Values):
   a. Air flow rate in cfm.
   b. Air velocity in fpm.
   c. Preliminary air flow rate as needed in cfm.
   d. Preliminary velocity as needed in fpm.
   e. Final air flow rate in cfm.
   f. Final velocity in fpm.
   g. Space temperature in deg F.

H. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
   1. Unit Data:
      a. System and air-handling-unit identification.
      b. Location and zone.
      c. Room or riser served.
      d. Coil make and size.
      e. Flowmeter type.
   2. Test Data (Indicated and Actual Values):
      a. Air flow rate in cfm.
      b. Entering-water temperature in deg F.
      c. Leaving-water temperature in deg F.
      d. Water pressure drop in feet of head or psig.
      e. Entering-air temperature in deg F.
      f. Leaving-air temperature in deg F.

I. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
   1. Unit Data:
      a. Unit identification.
      b. Location.
      c. Service.
      d. Make and size.
      e. Model number and serial number.
      f. Water flow rate in gpm.
      g. Water pressure differential in feet of head or psig.
      h. Required net positive suction head in feet of head or psig.
i. Pump rpm.

j. Impeller diameter in inches.

k. Motor make and frame size.

l. Motor horsepower and rpm.

m. Voltage at each connection.

n. Amperage for each phase.

o. Full-load amperage and service factor.

p. Seal type.

2. Test Data (Indicated and Actual Values):
   a. Static head in feet of head or psig.
   b. Pump shutoff pressure in feet of head or psig.
   c. Actual impeller size in inches.
   d. Full-open flow rate in gpm.
   e. Full-open pressure in feet of head or psig.
   f. Final discharge pressure in feet of head or psig.
   g. Final suction pressure in feet of head or psig.
   h. Final total pressure in feet of head or psig.
   i. Final water flow rate in gpm.
   j. Voltage at each connection.
   k. Amperage for each phase.

J. Instrument Calibration Reports:
   1. Report Data:
      a. Instrument type and make.
      b. Serial number.
      c. Application.
      d. Dates of use.
      e. Dates of calibration.

3.17 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.

   2. Check the following for each system:
      a. Measure airflow of at least 10 percent of air outlets.
      b. Measure water flow of at least 5 percent of terminals.
      c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
d. Verify that balancing devices are marked with final balance position.

e. Note deviations from the Contract Documents 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 by Construction Manager or Commissioning Authority.

2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Construction Manager or Commissioning Authority.

3. Construction Manager or Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

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.

3.18 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Single-wall rectangular ducts and fittings.
   2. Single-wall round ducts and fittings.
   4. Duct liner.
   5. Sealants and gaskets.
   6. Hangers and supports.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.3 SUBMITTALS

A. Product Data: For each type of the following products:
   1. Liners and adhesives.
   2. Sealants and gaskets.

B. Shop Drawings:
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Factory- and shop-fabricated ducts and fittings.
   3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
   4. Elevation of top of ducts.
   5. Dimensions of main duct runs from building grid lines.
   6. Fittings.
   7. Reinforcement and spacing.
   8. Seam and joint construction.
   9. Penetrations through fire-rated and other partitions.
   10. Equipment installation based on equipment being used on Project.
   11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
   12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:
1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

D. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.
   f. Perimeter moldings.

E. Welding certificates.
F. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
C. **Longitudinal Seams:** Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. **Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction:** Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### 2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. **General Fabrication Requirements:** Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. **Transverse Joints:** Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. **Transverse Joints in Ducts Larger Than 60 Inches in Diameter:** Flanged.

C. **Longitudinal Seams:** Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

D. **Tees and Laterals:** Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### 2.3 SHEET METAL MATERIALS

A. **General Material Requirements:** Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. **Galvanized Sheet Steel:** Comply with ASTM A 653/A 653M.


2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. **Stainless-Steel Sheets:** Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.

4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.


6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CertainTeed Corporation; Insulation Group.
   b. Johns Manville.
   c. Knauf Insulation.
   d. Owens Corning.

2. Maximum Thermal Conductivity:
   a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
   a. 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).

B. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.

4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.

6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.

7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
   a. Fan discharges.
   b. Intervals of lined duct preceding unlined duct.
   c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
   a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:
   1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
   2. Tape Width: 4 inches.
   5. Mold and mildew resistant.
   6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
   7. Service: Indoor and outdoor.
   8. Service Temperature: Minus 40 to plus 200 deg F.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
   10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.
   2. Type: S.
   3. Grade: NS.
   5. Use: O.
   6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:
   1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
   2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
   3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
H. Trapeze and Riser Supports:
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION
A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
C. Install round ducts in maximum practical lengths.
D. Install ducts with fewest possible joints.
E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK
A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT
A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.
B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.

C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
   1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   2. Outdoor, Supply-Air Ducts: Seal Class A.
   3. Outdoor, Exhaust Ducts: Seal Class C.
   4. Outdoor, Return-Air Ducts: Seal Class C.
   5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
   6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
   7. Unconditioned Space, Exhaust Ducts: Seal Class C.
   8. Unconditioned Space, Return-Air Ducts: Seal Class B.
   9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
  10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
  11. Conditioned Space, Exhaust Ducts: Seal Class B.
  12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
   5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 **CONNECTIONS**

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 **PAINTING**

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.8 **FIELD QUALITY CONTROL**

A. Perform tests and inspections.

B. Leakage Tests:
   2. Test the following systems:
      a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
   3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
   4. Test for leaks before applying external insulation.
   5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
   6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:
   1. Visually inspect duct system to ensure that no visible contaminants are present.
   2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
      a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 **START UP**

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.10 **DUCT SCHEDULE**

A. Supply Ducts (minimum gauge 26):
   1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
      a. Pressure Class: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 8.
d. SMACNA Leakage Class for Round and Flat Oval: 4.

2. Ducts Downstream of Terminal Air Boxes:
   a. Pressure Class: Positive 1-inch wg.
   b. Minimum SMACNA Seal Class: B.
   c. SMACNA Leakage Class for Rectangular: 8.
   d. SMACNA Leakage Class for Round and Flat Oval: 4.

3. Ducts Connected to Constant-Volume Air-Handling Units:
   a. Pressure Class: Positive 3-inch wg.
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 4.
   d. SMACNA Leakage Class for Round and Flat Oval: 2.

4. Ducts Connected to Variable-Air-Volume Air-Handling Units:
   a. Pressure Class: Positive 4-inch wg.
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 4.
   d. SMACNA Leakage Class for Round and Flat Oval: 2.

5. Ducts Connected to Equipment Not Listed Above:
   a. Pressure Class: Positive 3-inch wg.
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 4.
   d. SMACNA Leakage Class for Round and Flat Oval: 2.

B. Return Ducts (minimum gauge 26):

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
   a. Pressure Class: Positive or negative 1-inch wg.
   b. Minimum SMACNA Seal Class: B.
   c. SMACNA Leakage Class for Rectangular: 8.
   d. SMACNA Leakage Class for Round and Flat Oval: 4.

2. Ducts Connected to Air-Handling Units:
   a. Pressure Class: Positive or negative 2-inch wg for plenum return, 3-inch wg for ducted return.
   b. Minimum SMACNA Seal Class: B.
   c. SMACNA Leakage Class for Rectangular: 8.
   d. SMACNA Leakage Class for Round and Flat Oval: 4.

3. Ducts Connected to Equipment Not Listed Above:
   a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 8.
d. SMACNA Leakage Class for Round and Flat Oval: 4.

C. Exhaust Ducts (minimum gauge 26):
1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
   a. Pressure Class: Negative 2-inch wg.
   b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
   c. SMACNA Leakage Class for Rectangular: 8.
   d. SMACNA Leakage Class for Round and Flat Oval: 4.

2. Ducts Connected to Shower Exhaust:
   a. Aluminum sheet.
   b. Flanged joints with watertight EPDM gaskets.
   c. Pressure Class: Positive or negative 2-inch wg.
   d. Caulked seams, joints, and penetrations.
   e. SMACNA Leakage Class for Rectangular: 4.
   f. SMACNA Leakage Class for Round and Flat Oval: 2.

   a. Exposed to View: Type 304, stainless-steel sheet, No. 4 finish.
   c. Welded seams and joints.
   d. Pressure Class: Positive or negative 4-inch wg.
   e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
   f. SMACNA Leakage Class: 3.

4. Ducts Connected to Equipment Not Listed Above:
   a. Pressure Class: Positive or negative 3-inch wg.
   b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
   c. SMACNA Leakage Class for Rectangular: 8.
   d. SMACNA Leakage Class for Round and Flat Oval: 4.

D. Intermediate Reinforcement:
1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
2. Stainless-Steel Ducts:
   a. Exposed to Airstream: Match duct material.
   b. Not Exposed to Airstream: Match duct material.
3. Aluminum Ducts: Aluminum.

E. Liner:
1. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.
F. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
   a. Velocity 1000 fpm or Lower:
      1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
      2) Mitered Type RE 4 without vanes.
   b. Velocity 1000 to 1500 fpm:
      1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
      2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
      3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
   c. Velocity 1500 fpm or Higher:
      1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
      2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
      3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
   a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      4) Radius-to-Diameter Ratio: 1.5.
   b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

G. Branch Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
   a. Velocity 1000 fpm or Lower: 90-degree tap.
   b. Velocity 1000 to 1500 fpm: Conical tap.
   c. Velocity 1500 fpm or Higher: 45-degree lateral.
END OF SECTION 23 31 13
SECTION 23 34 23
HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes the following:
   1. Centrifugal roof ventilators.
   2. In-line centrifugal fans.

1.2 PERFORMANCE REQUIREMENTS
A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
B. Operating Limits: Classify according to AMCA 99.

1.3 SUBMITTALS
A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
   1. Certified fan performance curves with system operating conditions indicated.
   2. Certified fan sound-power ratings.
   3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
   4. Material thickness and finishes, including color charts.
   5. Dampers, including housings, linkages, and operators.
   6. Roof curbs.
   7. Fan speed controllers.
B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
C. Field quality-control test reports.
D. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.4 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. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
D. UL Standard: Power ventilators shall comply with UL 705.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
C. Lift and support units with manufacturer's designated lifting or supporting points.

1.6 COORDINATION

A. Coordinate size and location of structural-steel support members.
B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Aerovent; a Twin City Fan Company
   3. American Coolair Corp.
   4. Ammerman; General Resource Corp.
   5. Breidert Air Products.
   7. Carnes Company HVAC.
   8. Central Blower Co.
   10. Delhi Industries Inc.
   12. Hartzell Fan, Inc.
   13. JencoFan; Div. of Breidert Air Products.
   14. Loren Cook Company.
   15. NuTone Inc.
   17. Quietaire Corporation.
   18. Twin City Fan.

B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

C. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
   1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
   1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
   4. Fan and motor isolated from exhaust airstream.
F. Accessories:

1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
2. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
3. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

G. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.

1. Configuration: Self-flashing without a cant strip, with mounting flange.
2. Overall Height: 18 inches.

2.2 IN-LINE CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. American Coolair Corp.
3. Ammerman; General Resource Corp.
4. Bayley Fans; a division of Lau Industries, Inc.
5. Breidert Air Products.
6. Carnes Company HVAC.
7. FloAire.
8. Greenheck.
9. Hartzell Fan, Inc.
10. JencoFan; Div. of Breidert Air Products.
11. Loren Cook Company.
13. Penn Ventilation.
15. Twin City Fan.

B. Description: In-line, direct or belt-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.

C. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

D. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

E. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

F. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

G. Accessories:
1. **Companion Flanges:** For inlet and outlet duct connections.

2. **Motor and Drive Cover (Belt Guard):** Epoxy-coated steel.

### 2.3 MOTORS

A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

B. Enclosure Type: Totally enclosed, fan cooled.

### 2.4 SOURCE QUALITY CONTROL

A. **Sound-Power Level Ratings:** Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. **Fan Performance Ratings:** Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Secure roof-mounting fans to roof curbs with cadmium-plated hardware.

C. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch.

D. Install units with clearances for service and maintenance.

E. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

#### 3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

#### 3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.

2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.

3. Verify that cleaning and adjusting are complete.

4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.

5. Adjust belt tension.

6. Adjust damper linkages for proper damper operation.

7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.

9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.

10. Shut unit down and reconnect automatic temperature-control operators.

11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.
END OF SECTION 23 34 23
SECTION 23 37 13
DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Grilles, registers, and diffusers.

1.2 SUBMITTALS
A. Product Data: For each type of product indicated, include the following:
   1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 GRILLES, REGISTERS, AND DIFFUSERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Anemostat Products; a Mestek company.
   2. Carnes.
   3. Hart & Cooley Inc.
   4. METALAIRE, Inc.
   5. Nailor Industries Inc.
   7. Titus.
   8. Tuttle & Bailey.
B. Refer to schedule on drawings for descriptions of grilles, registers, and diffusers.

2.2 SOURCE QUALITY CONTROL
A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION
A. 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.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION
A. Install diffusers, registers, and grilles level and plumb.
B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume,
noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13
SECTION 26 05 01
MECHANICAL AND ELECTRICAL COORDINATION

PART 1: GENERAL

1.01 RELATED DOCUMENTS
A. Drawings, Contract Forms, Conditions of the Contract, Construction Manager at Risk (CMR) Agreement including Supplemental General Conditions and Exhibits, and other Division 01 Specification Sections, apply to this Section.

1.02 RESPONSIBILITY
A. The Divisions 21 through 23 and 26 through 28, contractor(s) shall comply with the provisions of this section. The Divisions 21 through 23 contractor(s) shall verify electrical service provided by the electrical contractor before ordering any mechanical equipment requiring electrical connections. Provide submittals of all mechanical equipment to Division 26 through 28 contractor(s).

B. The final responsibility for properly coordinating the electrical work of this section shall belong to the Divisions 21 through 23 system contractor performing the work, which requires the electrical power.

   1. Each Divisions 21 through 23 contractors shall be responsible for providing power wiring for certain devices as described in the specifications and on the drawings. This work shall be provided by a licensed electrician in accordance with all of the applicable provisions of the Division 26 through 28 specifications, NEC and local codes.

1.03 WORK INCLUDED
A. Carefully coordinate the interface between Divisions 21 through 23 (Mechanical) and Divisions 26 through 28 (Electrical), and Division 230900 (Building Management and Automatic Temperature Control Systems) before submitting any equipment for review or commencing installation.

1.04 DEFINITIONS
A. Automatic: Pertaining to a function, operation, process or device that, under specified conditions, functions without intervention by human operator.

B. Disconnect Switch: A mechanical switching device used for changing the connections in a circuit, or for isolating a circuit or equipment from a power source.

C. Control Circuit/Power: The circuit which carries the electrical signals of a control apparatus or system directing the performance of the controller but does not carry the main power circuit.

D. Manual Operation: Operation by hand without the use of any other power.

E. MC: Mechanical Contractor = Divisions 21 through 23 Contractor who furnishes motor.

F. TC: Temperature Controls = Division 230900 Contractor who furnishes control.

G. EC: Electrical Contractor = Divisions 26 through 28 Contractor.

H. FA: Fire Alarm Contractor = Division 28 Contractor who furnishes Fire Alarm System.

1.05 RESPONSIBILITY SCHEDULE
A. Responsibility: Unless otherwise indicated, all motors and controls for Divisions 21 through 23 equipment shall be furnished, set in place and wired in accordance with the following schedule:

B.
<table>
<thead>
<tr>
<th>ITEM</th>
<th>MC: Mechanical Contractor</th>
<th>TC: Temperature Contractor</th>
<th>EC: Electrical Contractor</th>
<th>FA: Fire Alarm Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHU Interior Marine Lights</td>
<td>MC</td>
<td>MC</td>
<td>EC</td>
<td>MC</td>
</tr>
<tr>
<td>Equipment Motors</td>
<td>MC</td>
<td>MC</td>
<td>EC</td>
<td>--</td>
</tr>
<tr>
<td>Automatically or Manually Controlled</td>
<td>EC</td>
<td>EC</td>
<td>EC</td>
<td>TC</td>
</tr>
<tr>
<td>Starters/Contactors: (Note 4)</td>
<td>MC or TC</td>
<td>MC or TC</td>
<td>EC or TC</td>
<td>TC or MC</td>
</tr>
<tr>
<td>-Separate</td>
<td>EC</td>
<td>EC</td>
<td>EC</td>
<td>TC</td>
</tr>
<tr>
<td>-Factory Mounted and Wired</td>
<td>MC</td>
<td>MC</td>
<td>EC</td>
<td>TC</td>
</tr>
<tr>
<td>Motor Speed Controllers: (Note 4)</td>
<td>MC or TC</td>
<td>MC or TC</td>
<td>EC or TC</td>
<td>TC</td>
</tr>
<tr>
<td>-Separate</td>
<td>MC</td>
<td>EC</td>
<td>EC</td>
<td>TC</td>
</tr>
<tr>
<td>-Factory Mounted and Wired</td>
<td>MC</td>
<td>MC</td>
<td>EC</td>
<td>TC</td>
</tr>
<tr>
<td>Disconnect Switches (Note 1)</td>
<td>EC</td>
<td>EC</td>
<td>EC</td>
<td>--</td>
</tr>
<tr>
<td>Thermal Overload Switches (Note 1)</td>
<td>EC</td>
<td>EC</td>
<td>EC</td>
<td>--</td>
</tr>
<tr>
<td>Switches (Manual or Automatic other than disconnect) (Note 2)</td>
<td>MC or TC</td>
<td>MC or TC</td>
<td>EC or TC</td>
<td>TC or MC</td>
</tr>
<tr>
<td>Control Relays (Note 2)</td>
<td>MC or TC</td>
<td>MC or TC</td>
<td>EC or TC</td>
<td>TC</td>
</tr>
<tr>
<td>Control Transformers</td>
<td>MC or TC</td>
<td>MC or TC</td>
<td>EC or TC</td>
<td>TC</td>
</tr>
<tr>
<td>Push Button Stations, Pilot Lights</td>
<td>MC</td>
<td>EC</td>
<td>EC</td>
<td>EC</td>
</tr>
<tr>
<td>Thermostat and Controls: Integral with Equipment or Directly Attached to Ducts, Pipes, etc. (Note 2)</td>
<td>MC or TC</td>
<td>EC or TC</td>
<td>EC or TC</td>
<td>TC</td>
</tr>
<tr>
<td>Equipment in Temperature Control Panels</td>
<td>TC</td>
<td>TC</td>
<td>TC</td>
<td>TC</td>
</tr>
<tr>
<td>Standalone Control Panels (BAS) (Note 6)</td>
<td>TC</td>
<td>TC</td>
<td>TC</td>
<td>TC</td>
</tr>
<tr>
<td>Valve Motors, Damper Motors, Solenoid Valves, etc.</td>
<td>TC</td>
<td>TC</td>
<td>TC</td>
<td>TC</td>
</tr>
<tr>
<td>Fire Alarm System</td>
<td>FA</td>
<td>FA</td>
<td>EC</td>
<td>FA</td>
</tr>
<tr>
<td>Fire Sprinkler Alarm</td>
<td>MC</td>
<td>MC</td>
<td>EC</td>
<td>FA</td>
</tr>
<tr>
<td>Duct System</td>
<td>FA</td>
<td>MC</td>
<td>--</td>
<td>TC/FA</td>
</tr>
<tr>
<td>Smoke Detectors (Note 5)</td>
<td>FA</td>
<td>MC</td>
<td>--</td>
<td>TC</td>
</tr>
<tr>
<td>Relays for Fan Control via duct detectors (Note 5)</td>
<td>MC</td>
<td>MC</td>
<td>EC</td>
<td>TC</td>
</tr>
<tr>
<td>Room Smoke Detectors Including</td>
<td>FA</td>
<td>FA</td>
<td>--</td>
<td>FA</td>
</tr>
<tr>
<td>Relays for Fan Control</td>
<td>TC</td>
<td>TC</td>
<td>--</td>
<td>TC</td>
</tr>
</tbody>
</table>

No. 195015  26 05 01-2  Mechanical and Electrical Coordination
C. Notes:

1. If furnished as part of factory wired equipment furnished and set in place by MC, wiring and connections by EC.

2. If float switches, line thermostats, time switches, or other controls carry the FULL LOAD CURRENT to any motor, they shall be furnished by MC, but they shall be set in place and connected by EC, except where such items are an integral part of the mechanical equipment, or directly attached to ducts, piping, or other mechanical equipment, they shall be furnished and set in place by MC and connected by EC. If they do not carry the FULL LOAD CURRENT to any motor, they shall be furnished, set in place and wired by TC contractor.

3. Not used.

4. Electrical contractor is responsible for wiring from starter to motor, unless factory wired.

5. Temperature control contractor shall provide conduit and wire from auxiliary contact in motor starter to the detector so that the unit shuts down in all operating modes. Fire Alarm Contractor to wire from detector to fire alarm panel.

6. Each division shall be fully responsible for any control panels as called for on the drawings or specifications.
   a. Division 26 shall provide all power and control wiring to fire/smoke or smoke dampers. Division 23 and 26/28 shall provide parallel control wiring (with 28 fire alarm having priority signal) to dampers and equipment utilized in both normal and smoke control modes. Refer to Fire Alarm Drawings.
   b. Not Used.
   c. TC wiring required only when damper also serves HVAC system.

D. Power Wiring by Divisions 21 through 23: The electrical power for certain equipment provided under Divisions 21 through 23 has not been specifically indicated on the electrical drawings and must be provided by and field coordinated by the Divisions 21 through 23 trade requiring such power. Sufficient power for this purpose shall be furnished as “spare” dedicated circuit capacity in Division 26’s panelboards. All wiring, conduit and electrical devices downstream of the panelboards is the responsibility of the Divisions 21 through 23 trade requiring the power.

1. Such equipment is hereby defined as:
   a. Temperature control panels and line voltage power for 24V control transformers. Required connections are included in Division 23 09 00 and will be shown by that contractor’s control submittal drawings.

1.06 GENERAL REQUIREMENTS

A. Connections:
1. Connections to all controls directly attached to ducts, piping and mechanical equipment shall be made with flexible connections.

B. Starters:
   1. Provide magnetic starters for all three phase motors and equipment complete with:
      a. Control transformers.
      b. 120V holding coils.
      c. Integral hand-off-auto switch.
      d. Auxiliary contacts required for system operation plus one (1) spare.
      e. Refer to Section 22 05 13 - Common Motor Requirements for Plumbing Equipment and 230513 - Common Motor Requirements for HVAC Equipment.

C. Remote Switches and Pushbutton Stations:
   1. Provide remote switches and/or pushbutton stations required for manually operated equipment (if no automatic controls have been provided) complete with pilot lights of an approved type lighted by current from load side of starter.

D. Special Requirements:
   1. Motors, starters and other electrical equipment installed in moist areas or areas of special conditions, such as explosion proof, shall be designed and approved for installation in such areas with appropriate enclosure.

E. Identification:
   1. Provide identification of purpose for each switch and/or pushbutton station furnished. Identification may be either engraved plastic sign permanently mounted to wall below switch, or stamping on switch cover proper. All such identification signs and/or switch covers in finished areas shall match other hardware in the immediate area.

F. Control Voltage:
   1. Maximum allowable control voltage 120V. Fully protect control circuit conductors in accordance with National Electrical Code.

G. DDC Control Interface:
   1. Fully coordinate the requirements of each division with regard to supplying a complete DDC Control System prior to submitting bid.
   2. All control power shall be furnished via dedicated line voltage circuits.
   3. Dedicated control circuits from electrical panelboards to DDC control panels and from electrical panelboards to dedicated DDC J-boxes (for distributed control components such as VAV boxes), and control transformer line voltage connections shall be provided under Division 23 09 00 where required and as shown on the drawings.
      a. Exceptions: The following Divisions 21 through 23 equipment has been provided with electrical power feeders downstream of the panelboards by Division 26:
         1) Division 28, Fire Alarm System Panels.
         2) Each Energy Recovery Ventilator (ERV) has been provided with a dedicated combination control and unit lighting circuit(s) to its air handling room.
         3) See the drawings for additional exceptions.
4. Low voltage wiring from J-boxes to distributed control components, all low voltage connections, all control panels and all control transformers (not part of unitary equipment) shall be provided under Division 23 09 00.

5. Any additional power requirements shall be the responsibility of the Division 23 09 00 Contractor requiring same, and provided at no additional cost to the owner.

1.07 CEILING AND CHASE CAVITY PRECEDENCE

A. Coordinate ceiling cavity space carefully with all trades.

B. Light fixtures have precedence in a zone, which is the same height above the ceiling as the depth of the fixture (plus 2”).

C. Examine the contract documents of all trades (e.g. all Divisions 21 through 23, and 26 through 28 drawings, the architectural floor plans, reflected ceiling plans, elevations and sections, structural plans and sections, etc.).

D. Coordinate necessary equipment, ductwork and piping locations so that the final installation is compatible with the materials and equipment of the other trades.

E. Prepare shop drawings for installation of all new work before installation to verify coordination of work between trades.

F. Provide access doors for all equipment, valves, clean-outs, actuators and controls which require access for adjustment or servicing and which are located in otherwise inaccessible locations.

1. For equipment located in “accessible locations” such as lay-in ceilings: Locate equipment to provide adequate service clearance for normal maintenance without removing architectural, mechanical, electrical or structural elements such as the ceiling support system, electrical fixtures, etc. “Normal maintenance” includes, but is not limited to: filter changing; greasing of bearings; using p/t ports for pressure or temperature measurements; and replacement of ballasts, fuses, etc.

PART 2: PRODUCTS

2.01 MOTOR HORSEPOWER

A. Voltage and phase of motors shall be as scheduled on the electrical drawings.

B. Work under Divisions 21 through 23 includes coordinating the electrical requirements of all mechanical equipment with the requirements of the work under Divisions 26 through 28, before ordering the equipment.

1. If motor horsepowers are changed under the work of Divisions 21 through 23 without a change in duty of the motor’s driven device, coordination of additional electrical work (if any) and additional payment for that work (if any) shall be provided under the section of Divisions 21 through 23 initiating the change. Increases or decreases in motor horsepower from that specified shall not be made without written approval from the Architect/Engineer.

PART 3: EXECUTION – (Not Used)
END OF SECTION 26 05 01
SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1: GENERAL

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

1.02 SUMMARY
A. Section Includes:
1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.03 DEFINITIONS
A. VFC: Variable frequency controller.

1.04 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Manufacturers: Firms regularly engaged in manufacture of electrical wire and cable products of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

PART 2: PRODUCTS

2.01 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. American Insulated Wire Anaconda-Ericsson Inc;
   2. Wire and Cable Div.
   3. Belden Div; Cooper Industries.
   5. General Cable Corporation
   6. Hitemp Wires, Inc.
   7. Phelps Dodge Cable and Wire Co.
   8. Rome Cable Corp.
   9. Southwire Company
   10. Okonite
   11. Superior Essex:
       a) Triangle
       b) Excel
       c) Royal
B. Aluminum and 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-2-THWN-2 and Type XHHW-2.

D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC with ground wire.

E. VFC Cable:
   1. Comply with UL 1277, UL 1685, and NFPA 70 for Type TC-ER cable.
   2. Type TC-ER with oversized crosslinked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire, and sunlight- and oil-resistant outer PVC jacket.
   3. Comply with UL requirements for cables in Classes I and II, Division 2 hazardous location applications.

2.02 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.
   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.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.03 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

3.01 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper for feeders up to 100 Amps; copper or aluminum for feeders over 100 Amps. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger, except VFC cable, which shall be extra flexible stranded.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.
C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-2-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2, single conductors in raceway or THHN-2, single conductors in raceway.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2, single conductors in raceway or Metal-clad cable, Type MC.

F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2, single conductors in raceway.

G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

H. VFC Output Circuits: Type XHHW-2 in metal conduit or Type TC-ER cable with braided shield.

3.03 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 26 05 33 "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 26 05 29 "Hangers and Supports for Electrical Systems."

3.04 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.05 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.07 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 07 84 13 "Penetration Firestopping."
SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1: GENERAL

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

1.02 SUMMARY
A. Section includes grounding and bonding systems and equipment.
B. Section includes grounding and bonding systems and equipment, plus the following special applications:
   1. Underground distribution grounding.
   2. Ground bonding common with lightning protection system.
   3. Foundation steel electrodes.

1.03 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.

PART 2: PRODUCTS

2.01 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Burndy; Part of Hubbell Electrical Systems.
   2. Dossert; AFL Telecommunications LLC.
   3. ERICO International Corporation.
   4. Fushi Copperweld Inc.
   5. Galvan Industries, Inc.; Electrical Products Division, LLC.
   6. Harger Lightning and Grounding.
   7. ILSCO.
   9. Robbins Lightning, Inc.
   10. Siemens Power Transmission & Distribution, Inc.

2.02 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 UL 467 for grounding and bonding materials and equipment.

2.03 CONDUCTORS
A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
B. Bare Copper Conductors:
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.04 CONNECTORS
A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

PART 3: EXECUTION
3.01 APPLICATIONS
A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
   1. Bury at least 24 inches below grade.
C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
   2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
D. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.

3.02 GROUNDING AT THE SERVICE
A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus.

3.03 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS
A. Comply with IEEE C2 grounding requirements.
3.04 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.05 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
END OF SECTION 26 05 26
SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1: GENERAL

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

1.02 SUMMARY
A. This Section includes the following:
1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.03 SUBMITTALS
A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
   a. Hangers.
   b. Steel slotted support systems.
   c. Nonmetallic support systems.
   d. Trapeze hangers.
   e. Clamps.
   f. Turnbuckles.
   g. Sockets.
   h. Eye nuts.
   i. Saddles.
   j. Brackets.

1.04 DEFINITIONS
A. EMT: Electrical metallic tubing.
B. IMC: Intermediate metal conduit.
C. RMC: Rigid metal conduit.

1.05 PERFORMANCE REQUIREMENTS
A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
C. 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.
1.06 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 07 72 00 "Roof Accessories."

PART 2: PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

      a. Allied Tube & Conduit.
      b. Cooper B-Line, Inc.
      c. ERICO International Corporation.
      d. GS Metals Corp.
      e. Thomas & Betts Corporation.
      f. Unistrut; Atkore International.
      g. Wesanco, Inc.

   2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

   3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

   4. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

   1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

      a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

         1) Hilti, Inc.
         2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
         3) MKT Fastening, LLC.
         4) Simpson Strong-Tie Co., Inc.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Cooper B-Line, Inc.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti, Inc.
      4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.


PART 3: EXECUTION

3.01 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
   1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

3.02 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.

5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.

6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.

7. To Light Steel: Sheet metal screws.

8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

**3.03 CONCRETE BASES**

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 03 30 00 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor bolts to elevations required for proper attachment to supported equipment.

3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

**3.04 PAINTING**

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Section 09 91 13 "Exterior Painting" Section 09 91 23 and "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29
PART 1: GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Metal conduits, tubing, and fittings.
   2. Nonmetal conduits, tubing, and fittings.
   3. Surface raceways.
   5. Handholes and boxes for exterior underground cabling.

1.03 DEFINITIONS
A. GRC: Galvanized rigid steel conduit.

1.04 ACTION SUBMITTALS
A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

PART 2: PRODUCTS

2.01 METAL CONDUITS, TUBING, 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.
   3. Anamet Electrical, Inc.
   4. Electri-Flex Company.
   5. O-Z/Gedney.
   6. Picoma Industries.
   7. Republic Conduit.
   8. Robroy Industries.
   10. Thomas & Betts Corporation.
   11. Triangle
   12. Western Tube and Conduit Corporation.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
C. GRC: Comply with ANSI C80.1 and UL 6.

D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
   1. Comply with NEMA RN 1.
   2. Coating Thickness: 0.040 inch, minimum.

E. EMT: Comply with ANSI C80.3 and UL 797.

F. FMC: Comply with UL 1; zinc-coated steel or aluminum.

G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

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 or die cast.
      b. Type: Setscrew or compression.
   3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
   4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

I. Joint Compound for GRC: 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.

2.02 NONMETALLIC CONDUITS, TUBING, 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. Anamet Electrical, Inc.
   3. Arnco Corporation.
   4. CANTEX Inc.
   5. CertainTeed Corporation.
   7. Electri-Flex Company.
   8. Kraloy.
   9. Lamson & Sessions; Carlon Electrical Products.
   10. Niedax-Kleinhuis USA, Inc.
   11. RACO; Hubbell.
   12. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ENT: Comply with NEMA TC 13 and UL 1653.
D. RNC: Type EPC-40-PVC or EPC-80-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
E. LFNC: Comply with UL 1660.
F. Continuous HDPE: Comply with UL 651B.
G. RTRC: Comply with UL 1684A and NEMA TC 14.
H. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
I. Fittings for LFNC: Comply with UL 514B.
J. 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).
K. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services’ “Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.”

2.03 SURFACE RACEWAYS
A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Mono-Systems, Inc.
      b. Panduit Corp.
      c. Wiremold / Legrand.
C. Tele-Power Poles:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Mono-Systems, Inc.
      b. Panduit Corp.
      c. Wiremold / Legrand.
   2. Material: Aluminum with clear anodized finish.
   3. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

2.04 BOXES, ENCLOSURES, AND CABINETS
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. Adalet.
   2. Cooper Technologies Company; Cooper Crouse-Hinds.
   3. EGS/Appleton Electric.
   5. FSR Inc.
8. Kraloy.
10. Mono-Systems, Inc.
12. RACO; Hubbell.
13. Robroy Industries.
14. Spring City Electrical Manufacturing Company.
15. Stahlin Non-Metallic Enclosures.
17. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.

E. Metal Floor Boxes:
   1. Material: Cast metal or sheet metal.
   2. Type: Semi-adjustable.
   3. Shape: Rectangular.
   4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Nonmetallic Floor Boxes: Nonadjustable, round.
   1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

H. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.
   1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

J. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

K. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

L. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

M. Gangable boxes are allowed.

N. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

O. Cabinets:
1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.05 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:
1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Armorcast Products Company.
   b. Carson Industries LLC.
   c. NewBasis.
   d. Nordic Fiberglass, Inc.
   e. Oldcastle Precast, Inc; Christy Concrete Products.
   g. Synertech Moulded Products.
2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC.".

PART 3: EXECUTION

3.01 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: EMT.
3. Underground Conduit, other than heavy traffic areas: RNC, Type EPC-40-PVC, direct buried.
4. Underground Conduit, loading dock and heavy traffic areas: RNC, Type EPC-80-PVC, direct buried.
5. Underground Conduit, branch circuits to site lighting and miscellaneous use power less than 30A: Continuous HDPE
6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
7. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
   a. Loading dock.
   b. CTE classrooms from floor to 8 feet above floor.
   c. Mechanical rooms.
   d. Gymnasiums.
   e. CTE Finishing Room classified hazardous area.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: GRC.
7. 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.

C. Minimum Raceway Size: 1/2-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10. Threaded galvanized steel, bushings shall have nylon insulated throat.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer. Threaded galvanized steel with external PVC coating, bushings shall have nylon insulated throat.
3. EMT: Use steel compression fittings. Comply with NEMA FB 2.10. Bushings shall be threaded and have nylon insulated throat or nylon bushing. Die-cast compression fittings will not be permitted.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20. Fittings: Cadmium plated, malleable iron. Straight connector shall be one piece body, female end with clamp and deep slotted machine screw for securing conduit, and threaded male end provided with a locknut. Angle connectors shall be two piece body with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, and threaded male end provided with a locknut. All fittings shall be terminated with threaded bushings having nylon insulated throats.

E. Do not use aluminum conduits, boxes, or fittings.
F. Install surface raceways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

H. Conduit sizes shall be as shown on the drawings. If the conduit size is not given on the drawings, the conduit shall be sized in accordance with NEC based on the number of conductors enclosed plus a parity sized equipment ground conductor and be subject to the following minimum sizes:
   1. Rigid, Intermediate, and EMT Conduit: 3/4 inch for all runs except lighting switch legs, 277 volt lighting branch circuits, temperature control and fire alarm which may be 1/2 inch.
   2. Flexible and Liquid-Tight Flexible Conduit: 1/2 inch for all runs.
   3. MC Cable: 3/8 inch to under-cabinet luminaires, 1/2 inch for all other runs.
   4. Underground or Concrete Encased Nonmetallic Conduit: 3/4 inch for all runs.
   5. Conduits used for home runs shall contain only the conductors for the circuits indicated on the drawings. Combining multiple home runs into a single conduit will not be permitted.
   6. All fire alarm system conduit shall be 3/4", minimum.

3.02 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. When boxes are located on opposite sides of a wall they shall be separated by a minimum of 4 inches horizontally. Back to back mounting of boxes is not allowed.

D. Complete raceway installation before starting conductor installation.

E. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.

F. Arrange stub-ups so curved portions of bends are not visible above finished slab.

G. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

H. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

I. Support conduit within 12 inches of enclosures to which attached.

J. Raceways Embedded in Slabs:
   1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
   2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
   3. Arrange raceways to keep a minimum of 1 inch of concrete cover in all directions.
   4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

K. Stub-ups to Above Recessed Ceilings:
   1. Use EMT or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

L. 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.

M. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

N. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Surface Raceways:
   1. Install surface raceway with a minimum 2-inch radius control at bend points.
   2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where an underground service raceway enters a building or structure.
   3. Where conduits pass from non-rated space to classified hazardous space with seal-offs as required by NFPA 70.
   4. Where otherwise required by NFPA 70.

V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

W. Expansion-Joint Fittings:
   1. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
   2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
      a. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
   3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion...
and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.

2. Use LFMC in damp or wet locations not subject to severe physical damage.

Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

BB. Locate boxes so that cover or plate will not span different building finishes.

CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

EE. Set metal floor boxes level and flush with finished floor surface.

FF. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 31 20 00 "Earth Moving" for pipe less than 6 inches in nominal diameter.

2. Install backfill as specified in Section 31 20 00 "Earth Moving."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 31 20 00 "Earth Moving."

4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

a. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

5. Underground Warning Tape: Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."
3.04 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES
   A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
   B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
   C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
   D. Install handholes with bottom 24 inches below grade.

3.05 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS
   A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.06 FIRESTOPPING
   A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.07 PROTECTION
   A. Protect coatings, finishes, and cabinets from damage and deterioration.
      1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
      2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33
SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Identification for raceways.
   2. Identification of power and control cables.
   3. Identification for conductors.
   5. Warning labels and signs.
   6. Instruction signs.
   7. Equipment identification labels.
   8. Miscellaneous identification products.

1.03 ACTION SUBMITTALS
A. Product Data: For each electrical identification product indicated.
B. Schedule of identification nomenclature to be used for identification signs and labels for each piece of equipment shall include, but not be limited to, the following equipment types as specified in Division 16.
   a. Cabinets and enclosures
   b. Switchboards and Switchgear
   c. Panelboards
   d. Disconnect switches
   e. Circuit breakers and switches for installation in distribution centers
   f. Motor control centers
   g. Starters
   h. Variable frequency drives
   i. Transfer switches
   j. Engine generators and all ancillary cabinets and equipment
   k. Fire alarm system panels and all ancillary cabinets and equipment
   l. Paging, intercom and background music system cabinets.
   m. Lighting control cabinets including dimmer cabinets.
C. Samples of each color, lettering style and other graphic representation required for identification materials; samples of labels and signs.

1.04 QUALITY ASSURANCE
A. Comply with ANSI A13.1.
B. Comply with NFPA 70.
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.

1.05 COORDINATION
A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
C. Coordinate installation of identifying devices with location of access panels and doors.
D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS
A. Clearly mark all pull box and junction box covers with voltage and circuit number(s) served for power raceways.
B. Clearly mark all control raceway pull box and junction box covers with system type.
C. Fire detection and alarm pull box and junction box covers shall be painted red and shall be clearly marked to indicate circuit type and circuit number.
D. Markings shall be permanent, waterproof black ink marker with minimum ½ inch high letters.

2.02 POWER AND CONTROL 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 cable size.
B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil-thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.
D. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
   1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.03 CONDUCTOR IDENTIFICATION MATERIALS
A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil-thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.
C. **Write-On Tags:** Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
   1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

D. **Adhesive Marking Labels for Raceway and Busway:** Pre-printed, flexible, self-adhesive labels with legend indicating voltage and service (Emergency, Lighting, Power, Power d.c., HVAC, Communications, Control, Fire).
   1. Label Size for Raceways and Busway: Kroy or Brother labels 1 inch high by 12 inches long (minimum) with 5/8 inch minimum height letters.
   2. Color: As specified for various systems.

### 2.04 FLOOR MARKING TAPE

A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

### 2.05 UNDERGROUND-LINE WARNING TAPE

A. **Tape:**
   1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
   2. Printing on tape shall be permanent and shall not be damaged by burial operations.
   3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. **Color and Printing:**
   1. Comply with ANSI Z535.1 through ANSI Z535.5.
   2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
   3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. **Tag:** Type I (Power):
   1. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
   2. Thickness: 4 mils.
   3. Weight: 18.5 lb/1000 sq. ft.
   4. 3-Inch Tensile According to ASTM D 882: 30 lbf, and 2500 psi.

D. **Tag:** Type ID (Control & Signal – Telephone, CATV, Communications, Optical Fiber):
   1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
   2. Overall Thickness: 5 mils.
   3. Foil Core Thickness: 0.35 mil.
   5. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.

### 2.06 WARNING LABELS AND SIGNS

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. 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. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
   3. Arc Flash Warning: “WARNING – ARC FLASH HAZARD” with additional information on personal protective safety equipment level required.

2.07 INSTRUCTION SIGNS
A. 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. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.08 EQUIPMENT IDENTIFICATION LABELS
A. 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. Overlay shall provide a weatherproof and UV-resistant seal for label.
B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.09 CABLE TIES
A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
   2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
   3. Temperature Range: Minus 40 to plus 185 deg F.
B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
   2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
   3. Temperature Range: Minus 40 to plus 185 deg F.
C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
   2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
   3. UL 94 Flame Rating: 94V-0.
   4. Temperature Range: Minus 50 to plus 284 deg F.
   5. Color: Black.

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS
A. Paint: Comply with requirements in 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

3.01 INSTALLATION

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 plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.
F. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
   1. Outdoors: UV-stabilized nylon.
   2. In Spaces Handling Environmental Air: Plenum rated.
G. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
H. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.02 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
   2. Power.
B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
   1. 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.
      c. Colors for 480/277-V Circuits:
         1) Phase A: Brown.
         2) Phase B: Orange.
         3) Phase C: Yellow.
d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches 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.

C. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

D. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive, self-laminating polyester labels with the conductor or cable designation, origin, and destination.

E. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive, self-laminating polyester labels with the conductor designation.

F. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

   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.

H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
   1. Limit use of underground-line warning tape to direct-buried cables.
   2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

I. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
   2. Identify system voltage with black letters on an orange background.
   3. Apply to exterior of door, cover, or other access.
   4. 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.
      c. Emergency lighting inverter connections.

K. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

L. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.
M. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, inverter units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:
   a. Indoor Junction, Pull and Connection Boxes: Adhesive film label with clear protective overlay. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
   b. Indoor Equipment: Engraved, laminated acrylic or melamine label.
   c. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
   d. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
   e. 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.

2. Equipment to Be Labeled:
   a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
   b. Enclosures and electrical cabinets.
   c. Access doors and panels for concealed electrical items.
   d. Switchboards.
   e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
   f. Emergency system boxes and enclosures.
   g. Enclosed switches.
   h. Enclosed circuit breakers.
   i. Enclosed controllers.
   j. Variable-speed controllers.
   k. Push-button stations.
   l. Power transfer equipment.
   m. Contactors.
   n. Remote-controlled switches, dimmer modules, and control devices.
   o. Battery-inverter units.
   p. Monitoring and control equipment.
END OF SECTION 26 05 53
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. Indoor ceiling mounted daylight-harvesting photosensors.
   2. Daylight harvesting dimming controls.
   3. Indoor occupancy sensors.
   4. Switch-box mounted occupancy sensors.
   5. Switch-box mounted time switches.
B. Related Requirements:
   1. Section 262726 "Wiring Devices" for wall-box dimmers and manual light switches.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Include photosensor color spectrum photosensitivity curve, showing correlation between sensitivity and human visual spectrum.
B. Shop Drawings: Show installation details for occupancy and light-level sensors.
   1. Interconnection diagrams showing field-installed wiring.
   2. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 INDOOR CEILING MOUNTED DAYLIGHT-HARVESTING PHOTOSENSORS
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. Cooper Industries, Inc.
   2. Hubbell Building Automation, Inc.
   3. Leviton Manufacturing Co., Inc.
   4. Lithonia Lighting; Acuity Brands Lighting, Inc.
   5. Sensor Switch, Inc.
   6. Watt Stopper
   7. NOTE: Philips sensors will not be accepted under any circumstances
B. System Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are 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. System programming is done with 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. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with separate controller unit, to detect changes in lighting levels that are perceived by the eye.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Sensor Output: 0- to 10-V dc to operate electronic dimming ballasts. Sensor is powered by controller unit.

3. Power Pack: Sensor has 24-V dc, Class 2 power source, as defined by NFPA 70.

4. Light-Level Sensor Set-Point Adjustment Range: 10 to 60 fc.

5. Cadmium sulfide photoresistors are not acceptable.

2.2 INDOOR OCCUPANCY SENSORS

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. Cooper Industries, Inc.

2. Hubbell Building Automation, Inc.

3. Leviton Manufacturing Co., Inc.

4. Lithonia Lighting; Acuity Brands Lighting, Inc.

5. Sensor Switch, Inc.

6. Watt Stopper

B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.

4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.

5. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outlet box.
b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.

c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.

7. Bypass Switch: Override the "on" function in case of sensor failure.

C. PIR Type: Not utilized for ceiling sensors on this project.

D. Ultrasonic Type: Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.

2. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot-high ceiling in a corridor not wider than 14 feet.

E. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.

2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.

3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.

2.3 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

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. Cooper Industries, Inc.

2. Hubbell Building Automation, Inc.

3. Leviton Manufacturing Co., Inc.

4. Lithonia Lighting; Acuity Brands Lighting, Inc.

5. Sensor Switch, Inc.

6. Watt Stopper

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.

3. Switch Rating: No minimum load rating for LED at 120 V nor LED at 277 V

C. Wall-Switch Sensor:

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft.

2. Sensing Technology: Dual technology - PIR and ultrasonic.
3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
4. Voltage: Dual voltage, 120 and 277 V; dual-technology type.
5. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
6. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

2.4 SWITCHBOX-MOUNTED TIMER SWITCHES

A. Products: Subject to compliance with requirements, provide one of the following:
   1. Cooper Industries, Inc.;
   2. Hubbell Building Automation, Inc.;
   3. Leviton Manufacturing Co., Inc.;
   4. Lithonia Lighting; Acuity Brands Lighting, Inc.;
   5. Sensor Switch, Inc;
   6. Watt Stopper;

B. General Requirements for Timer Switches: Pushbutton wall switch with multiple pre-sets time functions, suitable for mounting in a single gang switchbox.
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.

C. Switch Rating: No minimum load requirements for LED fixtures at 120v nor 277v.

D. Push-buttons with indicator lights for selecting between 1 minute to up to 60 minutes.

E. Lighted switch for visibility in darkened spaces.

2.5 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in 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. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 PHOTOELECTRIC SENSOR INSTALLATION

A. Install and aim sensors as recommended by manufacturer’s installation instructions. Sensors shall be placed in daylight zone.

B. Adjust photoelectric dimming sensors to provide the following maintained illuminance levels:
   1. Private Offices, Open Offices, Conference Rooms; Assembly Rooms: 40 FC.
   2. Lobby, Corridors, Public Open Spaces: 20 FC.

C. Adjustment and commissioning of daylight sensors will require at least two sets of field adjustments, first at night with no available daylight in space, and second during the day under daylight conditions.
D. Field coordinate placement of photoelectric sensors. Sensor shall not be placed in range of indirect illumination from lighting fixtures. Installation locations and heights shall be within manufacturer’s suggested range.

3.2 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 not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer’s written instructions.

C. Corridors shall utilize Ultrasonic Occupancy Sensors with sensor coverage pattern and layout optimized for fewest sensors needed for complete coverage, with minimum 10% overlap between sensors on same control zone. Corridor sensors and power packs shall be interconnected with Relay Based Lighting Controls 26 09 43.23. Sensors shall control lighting groups as indicated on Drawings and shall only be active during Relay Based Lighting Controls “Timed Off” periods. During “Timed On” periods sensors shall be inactive and lighting shall remain on.

D. Group Restrooms shall utilize Dual Technology Occupancy Sensors with sensor coverage pattern and layout optimized for fewest sensors needed for complete coverage including sensing within stall partition areas, with minimum 10% overlap between sensors on same control zone.

E. Single-user offices, multi-user offices, conference rooms, and similar spaces shall utilize Dual Technology Occupancy Sensors with sensor coverage pattern and layout optimized for fewest sensors needed for complete coverage including sensing within furniture and partition areas, with minimum 10% overlap between sensors on same control zone.

F. Single User Toilet Rooms and Custodian Room shall utilize wall switch with single level control and integral occupancy sensor.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.

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 tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3. Test every occupancy sensor for coverage sensitivity and time delay to off function.

4. Test every switch with manual controls for manual on/off and/or dimming level controls.

5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
B. Lighting control devices will be considered defective if they do not pass tests and inspections.
C. Prepare test and inspection reports.

3.6 ADJUSTING
A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
   1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
   2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.

3.7 DEMONSTRATION
A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Section 260943.23 "Relay-Based Lighting Controls."
B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 26 09 23
SECTION 26 27 26
WIRING DEVICES

PART 1:  GENERAL

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

1.02 SUMMARY
A. Section Includes:
1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Tamper-resistant receptacles.
5. Snap switches and wall-box dimmers.
6. Wall-switch and occupancy sensors.
7. Pendant cord-connector devices.
8. Cord and plug sets.
9. Floor service outlets and multioutlet assemblies.

1.03 DEFINITIONS
A. EMI: Electromagnetic interference.
B. GFCI: Ground-fault circuit interrupter.
C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
D. RFI: Radio-frequency interference.

1.04 ADMINISTRATIVE REQUIREMENTS
A. Coordination:
1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

1.05 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Product Data – Specialty Receptacles: Include product data for each type of specialty receptacle utilized on project including devices for Owner’s kitchen and shop equipment.

1.06 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

2.01 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.

### 2.02 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.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
   1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
   2. Devices shall comply with the requirements in this Section.

### 2.03 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 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, provide one of 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).

B. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.

   1. **Products:** Subject to compliance with requirements, provide one of the following:
      a. **Cooper:** TR8300.
      b. **Hubbell:** HBL8300SGA.
      c. **Leviton:** 8300-SGG.
      d. **Pass & Seymour:** TR63H.

   2. **Description:** Labeled shall comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

### 2.04 GFCI RECEPTACLES

A. General Description:

   1. Straight blade, feed-through type.
   2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
   3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
1. **Products**: Subject to compliance with requirements, provide one of the following:
   a. Cooper; VGF20.
   b. Hubbell; GFR5352L.
   c. Pass & Seymour; 2095.
   d. Leviton; 7590.

C. Tamper-Resistant GFCI Convenience Receptacles, 125 V, 20 A:
1. **Products**: Subject to compliance with requirements, provide one of the following:
   a. Hubbell; GFTR20.
   b. Pass & Seymour; 2095TR.

### 2.05 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

A. Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Cooper Crouse-Hinds.
   b. EGS/Appleton Electric.
   c. Killark; Division of Hubbell Inc.

### 2.06 TWIST-LOCKING AND STRAIGHT BLADE SPECIALTY RECEPTACLES

A. Single Convenience Receptacles, voltage, phase, wire and blade configuration as noted on Drawings: Comply with NEMA WD 1, NEMA WD 6 and UL 498.

### 2.07 PENDANT CORD-CONNECTOR DEVICES

A. Description:
   1. Matching, locking-type plug and receptacle body connector.
   2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
   4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

### 2.08 CORD AND PLUG SETS

A. Description:
   1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
   2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.

### 2.09 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:
   1) **Single Pole**:
2) Cooper; AH1221.
3) Hubbell; HBL1221.
4) Leviton; 1221-2.
5) Pass & Seymour; CSB20AC1.
6) Two Pole:
7) Cooper; AH1222.
8) Hubbell; HBL1222.
9) Leviton; 1222-2.
10) Pass & Seymour; CSB20AC2.
11) Three Way:
12) Cooper; AH1223.
13) Hubbell; HBL1223.
14) Leviton; 1223-2.
15) Pass & Seymour; CSB20AC3.
16) Four Way:
17) Cooper; AH1224.
18) Hubbell; HBL1224.
19) Leviton; 1224-2.
20) 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 "on."

D. Key-Operated Momentary-Contact Switches: 120/277 V, 20 A; for use with lighting control panel override in gymnasiums:
   1. **Products**: Subject to compliance with requirements, the following:
      a. Switches shall be matched to operate with lighting controls, 26 09 43.23 RELAY-BASED LIGHTING CONTROLS.
   2. **Description**: Momentary-Contact with key and three positions. Rotate counter-clockwise for OFF, center position neutral (key can only be inserted and removed from this position), and rotate clockwise for ON. Internal spring returns key to neutral position.
   3. **Cover**: Engraved with OFF and ON positions and adhesive label for lights controlled.

E. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 24-V; for use with low voltage controls in conjunction with low voltage vacancy sensors.
1. **Products:** Subject to compliance with requirements:
   
a. Switches shall be matched to operate with low voltage vacancy sensor lighting controls, 26 09 23 LIGHTING CONTROL DEVICES.

### 2.10 WALL-BOX DIMMERS

A. **Dimmer Switches:** Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. **Control:** Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

C. **Fluorescent Lamp Dimmer Switches:** Modular; compatible with 0-10V dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 5 percent of full brightness.

### 2.11 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:** Smooth, high-impact thermoplastic.
   
   3. **Material for Finished Spaces – Above Counters and in Kitchen:** 0.035-inch-thick, satin-finished, Type 302 stainless steel
   
   4. **Material for Unfinished Spaces:** Galvanized steel.
   
   5. **Material for Damp Locations:** Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. **All Receptacles to be stainless steel.**

C. **Wet-Location, Weatherproof Cover Plates:** NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

### 2.12 FLOOR SERVICE FITTINGS

A. **Type:** Modular, flush-type, dual-service units suitable for wiring method used.

B. **Compartments:** Barrier separates power from voice and data communication cabling.

C. **Service Plate:** Rectangular, die-cast aluminum with satin finish.

D. **Power Receptacle:** NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

E. **Voice and Data Communication Outlet:** Refer to Communications drawings and specifications.

### 2.13 PREFABRICATED MULTIOUTLET ASSEMBLIES

A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   
   1. **Hubbell Incorporated; Wiring Device-Kellems.**
   
   2. **Wiremold/LeGrand.**

B. **Description:**
   
   1. Two-piece surface metal raceway, with factory-wired multioutlet harness.
   
   2. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

C. **Raceway Material:** Metal, with manufacturer's standard stainless steel finish.

D. **Multioutlet Harness:**
1. Receptacles: 15-A, 125-V, NEMA WD 6 Configuration 5-15R receptacles complying with NEMA WD 1, UL 498, and FS W-C-596.

2. Receptacle Spacing: 12 inches.

3. Wiring: No. 12 AWG solid, Type THHN copper, single circuit.

2.14 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by architect unless otherwise indicated or required by NFPA 70 or device listing.

B. Wall Plate Color: For plastic covers, match device color.

1. Receptacles: All receptacles to be stainless steel.

PART 3: EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.

4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.

2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.

3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.

2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.

3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.

5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.

6. Use a torque screwdriver when a torque is recommended or required by manufacturer.

7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.

8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:
   1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:
   1. Install dimmers within terms of their listing.
   2. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates. Devices mounted above counters shall be mounted flush, with long dimension horizontal and grounding terminal of receptacles on right.

I. Adjust locations of floor service outlets to suit arrangement of partitions and furnishings.

3.02 GFCI RECEPTACLES
   A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.03 IDENTIFICATION
   A. Comply with Section 26 05 53 "Identification for Electrical Systems."
   B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.04 FIELD QUALITY CONTROL
   A. Perform the following tests and inspections:
      1. Test Instruments: Use instruments that comply with UL 1436.
      2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

   B. Tests for Convenience Receptacles:
      1. Line Voltage: Acceptable range is 105 to 132 V.
      2. Percent Voltage Drop under 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. Using the test plug, verify that the device and its outlet box are securely mounted.
      6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

   C. Wiring device will be considered defective if it does not pass tests and inspections.
   D. Prepare test and inspection reports.
END OF SECTION 26 27 26
PART 1: GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches and enclosed controllers.
   2. Spare-fuse cabinets.

1.03 ACTION SUBMITTALS
A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
   1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
      a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
      b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
   2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
   4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
   5. Coordination charts and tables and related data.
   6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.04 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
   1. Ambient temperature adjustment information.
   2. Current-limitation curves for fuses with current-limiting characteristics.
   3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
   4. Coordination charts and tables and related data.

1.05 MAINTENANCE MATERIAL SUBMITTALS
A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

1.06 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Comply with UL 248-11 for plug fuses.

1.07 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer’s ambient temperature adjustment factors to fuse ratings.

1.08 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

2.02 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3: EXECUTION

3.01 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Motor Branch Circuits: Class RK5, time delay.
2. Control Circuits: Class CC, fast acting.
3.03 INSTALLATION
   A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.04 IDENTIFICATION
   A. Install labels complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.
END OF SECTION 22 11 16
PART 1: GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Fusible switches.
   2. Nonfusible switches.
   3. Enclosures.

1.03 DEFINITIONS
A. NC: Normally closed.
B. NO: Normally open.
C. SPDT: Single pole, double throw.

1.04 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, and finishes.
   1. Enclosure types and details.
   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 and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power wiring.

1.05 MAINTENANCE MATERIAL SUBMITTALS
A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuse Pullers: Two for each size and type.

1.06 QUALITY ASSURANCE
A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
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. Comply with NFPA 70.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
   2. Altitude: Not exceeding 6800 feet.

1.08 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2: PRODUCTS

2.01 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 240 and 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
   4. Hookstick Handle: Allows use of a hookstick to operate the handle.
   5. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.02 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 240 and 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Hookstick Handle: Allows use of a hookstick to operate the handle.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.03 ENCLOSURES
A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3: EXECUTION
3.01 EXAMINATION
A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION
A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
B. Install fuses in fusible devices.
C. Comply with NECA 1.

3.03 IDENTIFICATION
A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.04 FIELD QUALITY CONTROL
A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
B. Perform tests and inspections.
C. Acceptance Testing Preparation:
   1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.
D. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Perform the following infrared scan tests and inspections and prepare reports:
   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
   b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
   c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. Enclosed switches will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies enclosed switches and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 26 28 16
PART 1 - GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Interior lighting fixtures, lamps, and drivers.
   2. Emergency lighting units.
   3. Exit signs.
   4. Lighting fixture supports.
B. Related Sections:
   1. Section 26 09 23 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
   2. Section 26 27 26 "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

1.03 DEFINITIONS
A. CCT: Correlated color temperature.
B. CRI: Color-rendering index.
C. Driver: Electronics components that couple to Light engine to convert power from line voltage AC to light engine operating mA output and voltage.
D. LED: Light Emitting Diode
E. LER: Luminaire efficacy rating.
F. Light Engine: One or more LEDs coupled to a circuit board with or without on board optics.
G. Lumen: Measured output of lamp and luminaire, or both.
H. Luminaire: Complete lighting fixture, including remote driver housing if provided.

1.04 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. Emergency lighting units including battery and charger.
   4. LED light engines for each type used. Provide compatibility information for LED light engines used in conjunction with dimming systems.
   5. Life, output (lumens, CCT, and CRI), of each light engine, and energy-efficiency data for light engines.
   6. 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. Solid state LED lighting photometric data based on IES LM-79 laboratory tests of each luminaire type, complete with indicated LED engines, power supplies, operating current in milliamps (mA), and accessories.

a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.

7. Power supplies, including energy-efficiency data.

8. LED engines, including life based on IES LM-80, output based on IES LM-79 testing methods, CCT, CRI, lumens, operating current in milliamps (mA), and energy-efficiency data.

B. Installation instructions.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1. Provide a list of all LED light engine and driver types used on Project; use manufacturers’ codes.

2. Provide recommended LED light engine and driver replacement schedule for each lamp type based on manufacturer’s listed lamp life ratings.

3. Provide manufacturer’s maintenance and trouble-shooting information for all luminaire.

1.06 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.

1.07 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.

1.08 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer’s standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency LED luminaire Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products indicated on Drawings.

B. Product Substitutions: Provide product data per “Action Submittals” for all proposed substitute products submitted during bid period for Architect and Engineer review. Substitute products are any products not specifically detailed on Drawings with full model numbers. Substitute products are subject to review and acceptance of Architect and Engineer. Listing on Drawings of alternate manufacturer’s names without detailed full model numbers does not equate to specific product approval or acceptance.
2.02 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. LED Fixtures: Test in accordance with IES LM79 & LM80.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. Diffusers and Globes:
   1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
      a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
      b. UV stabilized.
   2. Glass: Annealed crystal glass unless otherwise indicated.

G. Factory-Applied Labels: Comply with UL 1598. Include recommended replacement LED light engines and drivers. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
   1. Label shall include the following LED light engine and driver characteristics:
      a. "USE ONLY" and include specific LED light engine type.
      b. Driver info including operating mA output and wattage.
      c. CCT and CRI for all luminaires.

2.03 LED LIGHT SOURCE REQUIREMENTS

A. Solid State Lighting (LED) sources must meet the following requirements:
   1. Luminaires must be rated for -40°C to +50°C operation
   2. Correlated Color Temperature (CCT) shall be as specified.
   3. Color Rendering Index (CRI) of: ≥ 75
   4. Lumen Maintenance: ≥ 50,000 hours to 70% Lumen Maintenance per IES LM-80, tested per IES LM-79 procedures.

2.04 DRIVER REQUIREMENTS

A. Power Supply Units (PSUs) including drivers must meet the following requirements:
   1. Must have a minimum efficiency of 85%
   2. Must be rated to operate between -40°C to +50°C
   3. Input Voltage: capable of 120 to 277 (±10%) volt, single phase as required by the site.
   4. Power supplies can be UL Class I or II output.
   5. Operating frequency must be 60 Hz.
   6. Drivers must have a Power Factor (PF) of: ≥ 0.90.
   7. Drivers must have a Total Harmonic Distortion (THD) of: ≤ 20%.
9. Drivers must be Reduction of Hazardous Substances (RoHS) compliant.

10. Drivers for fixtures connected to dimmers must be compatible with specified dimming controls.

2.05 EMERGENCY LIGHTING UNITS

A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.
   1. Battery: Sealed, maintenance-free, lead-acid type.
   2. Charger: Fully automatic, solid-state type with sealed transfer relay.
   3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
   4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
   5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
   6. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.06 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
   1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.

2.07 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.


C. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.

D. Lamps, and sockets.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Lighting fixtures:
   1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
   2. Install lamps in each luminaire.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Remote Mounting of Drivers: Distance between the ballast and fixture shall not exceed that recommended by luminaire and driver manufacturer. Verify, with driver manufacturers, maximum distance between driver and luminaire.

D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.
1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners at minimum of two corners.

2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.

3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

4. Install at least two independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

E. Suspended Lighting Fixture Support:
   1. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.02 IDENTIFICATION
   A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.03 FIELD QUALITY CONTROL
   A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
   B. Test all dimmed luminaires with manual and automatic dimming controls. Verify proper dimming from low output to full output with each device type.
   C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.04 ADJUSTING
   A. 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 one 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.
END OF SECTION 26 51 00