



Allied Engineering

Structural Mechanical Electrical Commissioning

**Air Conditioning and Heating Upgrades
Cumberland County Courthouse
Portland, ME**

Issued for Bid

AEI 17-051

December 22, 2017

AIR CONDITIONING AND HEATING UPGRADES
CUMBERLAND COUNTY COURTHOUSE
PORTLAND, MAINE
ISSUED FOR BID
DECEMBER 22, 2017

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CUMBERLAND COUNTY COURTHOUSE
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CUMBERLAND COUNTY COURTHOUSE
PORTLAND, MAINE
ISSUED FOR BID
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DRAFT AIA® Document A101™ - 2007

Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

AGREEMENT made as of the « » day of « » in the year « »
(In words, indicate day, month and year.)

BETWEEN the Owner:
(Name, legal status, address and other information)

«Cumberland County Commissioners»« »
«Cumberland County Courthouse
142 Federal St
Portland, ME 04101-4169»
«Telephone Number: 207-871-8293»
«Fax Number: 207-632-5595»

and the Contractor:
(Name, legal status, address and other information)

« »« »
« »
« »
« »

for the following Project:
(Name, location and detailed description)

«Air Conditioning and Heating Upgrades at the Cumberland County Courthouse»
«Portland, ME»
« Expansion for the water cooled VRV system at the County Side of the Cumberland
County Courthouse in Portland, Maine.»

The Architect:
(Name, legal status, address and other information)

«Allied Engineering, Inc.»« »
«160 Veranda St.
Portland, ME 04103»
«Telephone Number: 207.221.2260»
«Fax Number: 207.221.2266»

The Owner and Contractor agree as follows.

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.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

AIA Document A201™-2007, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

ELECTRONIC COPYING of any portion of this AIA® Document to another electronic file is prohibited and constitutes a violation of copyright laws as set forth in the footer of this document.

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ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be the date of this Agreement unless a different date is stated below or provision is made for the date to be fixed in a notice to proceed issued by the Owner.
(Insert the date of commencement if it differs from the date of this Agreement or, if applicable, state that the date will be fixed in a notice to proceed.)

« »

If, prior to the commencement of the Work, the Owner requires time to file mortgages and other security interests, the Owner's time requirement shall be as follows:

« »

§ 3.2 The Contract Time shall be measured from the date of commencement.

§ 3.3 The Contractor shall achieve Substantial Completion of the entire Work not later than «» («») days from the date of commencement, or as follows:
(Insert number of calendar days. Alternatively, a calendar date may be used when coordinated with the date of commencement. If appropriate, insert requirements for earlier Substantial Completion of certain portions of the Work.)

« June 01, 2018 »

Portion of Work

Substantial Completion Date

Work associated with Courtroom #12

April 20, 2018

, subject to adjustments of this Contract Time as provided in the Contract Documents.
(Insert provisions, if any, for liquidated damages relating to failure to achieve Substantial Completion on time or for bonus payments for early completion of the Work.)

ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be <<>> (\$ <<>>), subject to additions and deductions as provided in the Contract Documents. The contract sum shall be broken out as follows:

All work associated with furnish and install for the new cooling tower and upgrades to the existing cooling tower: \$

All work associated with heating, ventilation, and air conditioning for Courtroom #12: \$

All other work not included in the above items: \$

§ 4.2 The Contract Sum is based upon the following alternates, if any, which are described in the Contract Documents and are hereby accepted by the Owner:

(State the numbers or other identification of accepted alternates. If the bidding or proposal documents permit the Owner to accept other alternates subsequent to the execution of this Agreement, attach a schedule of such other alternates showing the amount for each and the date when that amount expires.)

- A. Alternate No. 1: Heating and Air Conditioning upgrades at the Probate Court Suite at the First Floor area.
1. Base Bid: No work in this area.
2. Alternate: Furnish and install HP-16, HP-17, HP-18, ERU-5, BS-7, and CD-4 with all associated piping, ductwork, electrical, controls, and architectural requirements to add air conditioning and heating upgrades to the Probate Court Suite.
B. Alternate No. 2: Heating and Air Conditioning at the first floor Deeds Office.
1. Base Bid: No work in this area.
2. Alternate: Furnish and install HP-25 with all associated piping, ductwork, electrical, controls, and architectural requirements to add air conditioning and heating upgrades to the first floor Deeds Office.
C. Alternate No. 3: Heating and Air Conditioning Upgrades at the second floor Conference Room and Supreme Court Justice Suite
1. Base Bid: No work in this area.
2. Alternate: Furnish and install HP-22, HP-23, HP-24, ERU-7, BS-11, and CD-6 with all associated piping, ductwork, electrical, controls, and architectural requirements to add air conditioning and heating upgrades to the second floor Conference Room and Supreme Court Justice suite.
D. Alternate No. 4: Replace first floor corridor suspended acoustical tile

1. Base Bid: Remove and reinstall the suspended acoustical tile and grid within the first floor corridor to the extent necessary to complete the mechanical and electrical installation noted on the drawings. Note: for areas where the mechanical upgrades are included as alternates, the ceiling removal and replacement associated with those alternates shall be included in the appropriate alternate cost.
2. Alternate: Furnish and install new suspended acoustical tile ceiling system throughout the first floor corridor as indicated on the architectural drawings.

»

§ 4.3 Unit prices, if any:

(Identify and state the unit price; state quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price Per Unit (\$0.00)

§ 4.4 Allowances included in the Contract Sum, if any:

(Identify allowance and state exclusions, if any, from the allowance price.)

Item	Price

ARTICLE 5 PAYMENTS

§ 5.1 PROGRESS PAYMENTS

§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

« »

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the « 15th » day of a month, the Owner shall make payment of the certified amount to the Contractor not later than the «15th » day of the «FOLLOWING » month. If an Application for Payment is received by the Architect after the application date fixed above, payment shall be made by the Owner not later than « THIRTY » (« 30 ») days after the Architect receives the Application for Payment.

(Federal, state or local laws may require payment within a certain period of time.)

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be 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.

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.6 Subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

- .1 Take that portion of the Contract Sum properly allocable to completed Work as determined by multiplying the percentage completion of each portion of the Work by the share of the Contract Sum allocated to that portion of the Work in the schedule of values, less retainage of «SEVEN POINT FIVE » percent («7.5 » %). Pending final determination of cost to the Owner of changes in the Work, amounts not in dispute shall be included as provided in Section 7.3.9 of AIA Document A201™-2007, General Conditions of the Contract for Construction;

- .2 Add that portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction (or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing), less retainage of «SEVEN POINT FIVE » percent (« 7.5 » %);
- .3 Subtract the aggregate of previous payments made by the Owner; and
- .4 Subtract amounts, if any, for which the Architect has withheld or nullified a Certificate for Payment as provided in Section 9.5 of AIA Document A201–2007.

§ 5.1.7 The progress payment amount determined in accordance with Section 5.1.6 shall be further modified under the following circumstances:

- .1 Add, upon Substantial Completion of the Work, a sum sufficient to increase the total payments to the full amount of the Contract Sum, less such amounts as the Architect shall determine for incomplete Work, retainage applicable to such work and unsettled claims; and
(Section 9.8.5 of AIA Document A201–2007 requires release of applicable retainage upon Substantial Completion of Work with consent of surety, if any.)
- .2 Add, if final completion of the Work is thereafter materially delayed through no fault of the Contractor, any additional amounts payable in accordance with Section 9.10.3 of AIA Document A201–2007.

§ 5.1.8 Reduction or limitation of retainage, if any, shall be as follows:

(If it is intended, prior to Substantial Completion of the entire Work, to reduce or limit the retainage resulting from the percentages inserted in Sections 5.1.6.1 and 5.1.6.2 above, and this is not explained elsewhere in the Contract Documents, insert here provisions for such reduction or limitation.)

« »

§ 5.1.9 Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.2 FINAL PAYMENT

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

- .1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Section 12.2.2 of AIA Document A201–2007, and to satisfy other requirements, if any, which extend beyond final payment; and
- .2 a final Certificate for Payment has been issued by the Architect.

§ 5.2.2 The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect's final Certificate for Payment, or as follows:

« »

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 INITIAL DECISION MAKER

The Architect will serve as Initial Decision Maker pursuant to Section 15.2 of AIA Document A201–2007, unless the parties appoint below another individual, not a party to this Agreement, to serve as Initial Decision Maker.

(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

«Anthony Davis »

«Allied Engineering, Inc. »

«160 Veranda St. »

«Portland, ME 04103

Telephone Number: 207.221.2260 »

§ 6.2 BINDING DISPUTE RESOLUTION

For any Claim subject to, but not resolved by, mediation pursuant to Section 15.3 of AIA Document A201–2007, the method of binding dispute resolution shall be as follows:

(Check the appropriate box. If the Owner and Contractor do not select a method of binding dispute resolution below, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.)

Arbitration pursuant to Section 15.4 of AIA Document A201–2007

Litigation in a court of competent jurisdiction

Other (Specify)

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2007.

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2007.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2007 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

(Insert rate of interest agreed upon, if any.)

«1.5 » % «monthly »

§ 8.3 The Owner’s representative:
(Name, address and other information)

«Bruce Tarbox»
«Cumberland County Courthouse
142 Federal St
Portland, ME 04101-4169»

« »
« »
« »
« »

§ 8.4 The Contractor’s representative:
(Name, address and other information)

« »
« »
« »
« »
« »
« »

§ 8.5 Neither the Owner’s nor the Contractor’s representative shall be changed without ten days written notice to the other party.

§ 8.6 Other provisions:

« Prior to commencement of work in any area, the contractor shall be required to pass a Judicial Background test (Background Form 2013, attached), to be filled out and submitted one week prior to commencement of work at the site. »

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 The Contract Documents, except for Modifications issued after execution of this Agreement, are enumerated in the sections below.

§ 9.1.1 The Agreement is this executed AIA Document A101–2007, Standard Form of Agreement Between Owner and Contractor.

§ 9.1.2 The General Conditions are AIA Document A201–2007, General Conditions of the Contract for Construction.

§ 9.1.3 The Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

§ 9.1.4 The Specifications:

(Either list the Specifications here or refer to an exhibit attached to this Agreement.)

«See attached Table of Contents Specification List »

Section	Title	Date	Pages

§ 9.1.5 The Drawings:

(Either list the Drawings here or refer to an exhibit attached to this Agreement.)

« See attached Table of Contents Drawing List »

Number	Title	Date

§ 9.1.6 The Addenda, if any:

Number	Date	Pages

Portions of Addenda relating to bidding requirements are not part of the Contract Documents unless the bidding requirements are also enumerated in this Article 9.

§ 9.1.7 Additional documents, if any, forming part of the Contract Documents:

- 1 AIA Document E201™–2007, Digital Data Protocol Exhibit, if completed by the parties, or the following:

« »

- 2 Other documents, if any, listed below:

(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201–2007 provides that bidding requirements such as advertisement or invitation to bid, Instructions to Bidders, sample forms and the Contractor's bid are not part of the Contract Documents unless enumerated in this Agreement. They should be listed here only if intended to be part of the Contract Documents.)

«A201 – General Conditions of the Contract for Construction
A301 – Bid Bond
A312 – Payment Bond

ARTICLE 10 INSURANCE AND BONDS

The Contractor shall purchase and maintain insurance and provide bonds as set forth in Article 11 of AIA Document A201–2007.

(State bonding requirements, if any, and limits of liability for insurance required in Article 11 of AIA Document A201–2007.)

Type of insurance or bond	Limit of liability or bond amount (\$0.00)

This Agreement entered into as of the day and year first written above.

OWNER *(Signature)*
«Bruce Tarbox»«, Facilities Engineer»
(Printed name and title)

CONTRACTOR *(Signature)*
« »
(Printed name and title)



DRAFT AIA[®] Document A201[™] - 2007

General Conditions of the Contract for Construction

for the following PROJECT:

(Name and location or address)

«Air Conditioning and Heating Upgrades at the Cumberland County Courthouse»
«Portland, ME»

THE OWNER:

(Name, legal status and address)

«Cumberland County Commissioners»« »
«Cumberland County Courthouse
142 Federal St
Portland, ME 04101-4169»

THE ARCHITECT:

(Name, legal status and address)

«Allied Engineering, Inc.»« »
«160 Veranda St.
Portland, ME 04103»

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ADDITIONS AND DELETIONS:

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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 INITIAL DECISION MAKER

The 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.

§ 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.

§ 2.1.2 The Owner shall furnish to the Contractor within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of or enforce mechanic’s lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner’s interest therein.

§ 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 to the Contractor 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.

§ 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 Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 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

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.

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 if 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.

§ 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.

§ 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 shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 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.

§ 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
- .3 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.

§ 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.

§ 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. 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, 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 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 approved 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.

§ 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 of the Contract Documents.

§ 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 approved 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 approval 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 approval 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 approval 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.

§ 3.13 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.

§ 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 do so 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 that 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.

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.

§ 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 as 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 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 approve, or take other appropriate action 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, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, 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 for 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 14 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 14-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.

§ 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 responsibly 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 or 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 7.3.3.3, 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, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and workers' compensation insurance;
- .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 bonds and insurance, permit fees, and sales, use or similar taxes related to the Work; and
- .5 Additional costs of supervision and field office personnel directly attributable to the change.

§ 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.

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.

§ 8.2 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.

§ 8.3 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 mediation and arbitration; 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 to the Architect, before the first 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.

§ 9.3 APPLICATIONS FOR PAYMENT

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment 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, if required, 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.

§ 9.3.2 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 shut-down, 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.

§ 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 within which the Contractor shall finish all items on the list accompanying the Certificate. 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.

§ 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.

§ 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.

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; and
- .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.

§ 10.3 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.

§ 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.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall indemnify the Contractor for all cost and expense thereby incurred.

§ 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;
- .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.

§ 11.1.2 The insurance required by Section 11.1.1 shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater. Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from the date of commencement of the Work until the date of final payment and termination of any coverage required to be maintained after final payment, and, with respect to the Contractor's completed operations coverage, until the expiration of the period for correction of Work or for such other period for maintenance of completed operations coverage as specified in the Contract Documents.

§ 11.1.3 Certificates of insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work and thereafter upon renewal or replacement of each required policy of insurance. These certificates and the insurance policies required by this Section 11.1 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner. An additional certificate evidencing continuation of liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment as required by Section 9.10.2 and thereafter upon renewal or replacement of such coverage until the expiration of the time required by Section 11.1.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness.

§ 11.1.4 The Contractor shall cause the commercial liability coverage required by the Contract Documents to include (1) the Owner, the Architect and the Architect's consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's completed operations.

§ 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 Unless otherwise provided, the Owner 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 written on a builder's

risk “all-risk” or equivalent policy form in the amount of the initial Contract Sum, plus value of subsequent Contract Modifications and cost of materials supplied or installed by others, comprising total value for the entire Project at the site on a replacement cost basis without optional deductibles. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Section 9.10 or until no person or entity other than the Owner has an insurable interest in the property required by this Section 11.3 to be covered, whichever is later. This insurance shall include interests of the Owner, the Contractor, Subcontractors and Sub-subcontractors in the Project.

§ 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.

§ 11.3.1.2 If the Owner does not intend to purchase such property insurance required by the Contract and with all of the coverages in the amount described above, the Owner shall so inform the Contractor in writing prior to commencement of the Work. The Contractor may then effect insurance that will protect the interests of the Contractor, Subcontractors and Sub-subcontractors in the Work, and by appropriate Change Order the cost thereof shall be charged to the Owner. If the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain insurance as described above, without so notifying the Contractor in writing, then the Owner shall bear all reasonable costs properly attributable thereto.

§ 11.3.1.3 If the property insurance requires deductibles, the Owner shall pay costs not covered because of such deductibles.

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

§ 11.3.1.5 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.

§ 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.

§ 11.3.4 If the Contractor requests in writing that insurance for risks other than those described herein or other special causes of loss be included in the property insurance policy, the Owner shall, if possible, include such insurance, and the cost thereof shall be charged to the Contractor by appropriate Change Order.

§ 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 Owner shall file with the Contractor a copy of each policy that includes insurance coverages required by this Section 11.3. Each policy shall contain all generally applicable conditions, definitions, exclusions and endorsements related to this Project. Each policy shall contain a provision that the policy will not be canceled or allowed to expire, and that its limits will not be reduced, until at least 30 days' prior written notice has been given to the Contractor.

§ 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 proceeds of such insurance held by the Owner 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 the Owner's property insurance shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee 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 Owner as fiduciary shall, upon occurrence of an insured loss, give bond for proper performance of the Owner's duties. The cost of required bonds shall be charged against proceeds received as fiduciary. The Owner shall deposit in a separate account proceeds so received, which the Owner 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 Owner 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 Owner's exercise of this power; if such objection is made, the dispute shall be resolved in the manner selected by the Owner and Contractor as the method of binding dispute resolution in the Agreement. If the Owner and Contractor have selected arbitration as the method of binding dispute resolution, the Owner as fiduciary shall make settlement with insurers or, in the case of a dispute over distribution of insurance proceeds, in accordance with the directions of the arbitrators.

§ 11.4 PERFORMANCE BOND AND PAYMENT BOND

§ 11.4.1 The Owner shall have the right to require the Contractor to furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in bidding requirements or specifically required in the Contract Documents on the date of execution of the Contract.

§ 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 an applicable special warranty required by the Contract Documents, 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 to do so unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner 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 Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 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

The Contract shall be governed by the law of the place where the Project is located except that, if the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 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.

§ 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.

§ 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 there under, except as may be specifically agreed in writing.

§ 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

The Owner and Contractor shall commence all claims and causes of action, whether in contract, tort, breach of warranty or otherwise, against the other arising out of or related to the Contract in accordance with the requirements of the final dispute resolution method selected in the Agreement within the time period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all claims and causes of action not commenced in accordance with this Section 13.7.

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 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 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, along with reasonable overhead and profit on the Work not executed.

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, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of an initial decision, demand in writing that the other party file for mediation within 60 days of the initial decision. If such a demand is made and the party receiving the demand fails to file for mediation within the time required, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 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.

§ 15.2.8 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 Claims, disputes, or other matters in controversy arising out of or related to the Contract except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.6 shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4 ARBITRATION

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The

party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 15.4.4 CONSOLIDATION OR JOINDER

§ 15.4.4.1 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).

§ 15.4.4.2 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.

§ 15.4.4.3 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.

Bid Bond

CONTRACTOR:
(Name, legal status and address)

« »
« »

SURETY:
(Name, legal status and principal place of business)

« »
« »

OWNER:
(Name, legal status and address)

«Cumberland County Commissioners»
«Cumberland County Courthouse
142 Federal St
Portland, ME 04101-4169»

BOND AMOUNT: \$ « »

PROJECT:
(Name, location or address, and Project number, if any)

«Air Conditioning and Heating Upgrades at the Cumberland County Courthouse»
«Portland, ME»
« »

The Contractor and Surety are bound to the Owner in the amount set forth above, for the payment of which the Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, as provided herein. The conditions of this Bond are such that if the Owner accepts the bid of the Contractor within the time specified in the bid documents, or within such time period as may be agreed to by the Owner and Contractor, and the Contractor either (1) enters into a contract with the Owner in accordance with the terms of such bid, and gives such bond or bonds as may be specified in the bidding or Contract Documents, with a surety admitted in the jurisdiction of the Project and otherwise acceptable to the Owner, for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof; or (2) pays to the Owner the difference, not to exceed the amount of this Bond, between the amount specified in said bid and such larger amount for which the Owner may in good faith contract with another party to perform the work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect. The Surety hereby waives any notice of an agreement between the Owner and Contractor to extend the time in which the Owner may accept the bid. Waiver of notice by the Surety shall not apply to any extension exceeding sixty (60) days in the aggregate beyond the time for acceptance of bids specified in the bid documents, and the Owner and Contractor shall obtain the Surety's consent for an extension beyond sixty (60) days.

If this Bond is issued in connection with a subcontractor's bid to a Contractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

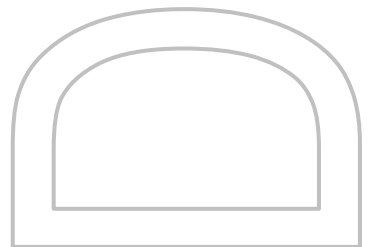
When this Bond has been furnished to comply with a statutory or other legal requirement in the location of the Project, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.



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.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.



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Signed and sealed this « » day of « », « »

(Witness)

(Witness)

« »

(Contractor as Principal) (Seal)

« »

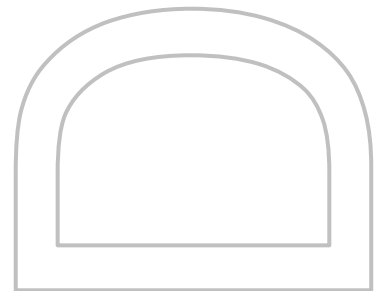
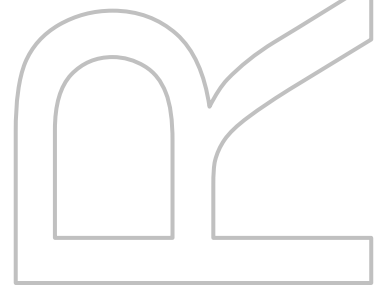
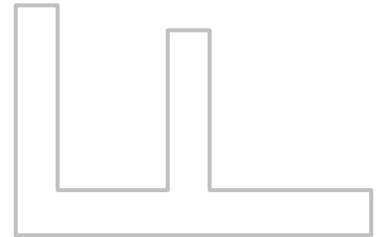
(Title)

« »

(Surety) (Seal)

« »

(Title)



DRAFT AIA® Document A312™ - 2010

Payment Bond

CONTRACTOR:

(Name, legal status and address)

« »
« »

SURETY:

(Name, legal status and principal place of business)

« »
« »

OWNER:

(Name, legal status and address)

«Cumberland County Commissioners»
«Cumberland County Courthouse
142 Federal St
Portland, ME 04101-4169»

CONSTRUCTION CONTRACT

Date: « »

Amount: \$ «»

Description:

(Name and location)

«Air Conditioning and Heating Upgrades at the Cumberland County Courthouse»
«Portland, ME»

BOND

Date:

(Not earlier than Construction Contract Date)

« »

Amount: \$ « »

Modifications to this Bond: None See Section 18

CONTRACTOR AS PRINCIPAL

Company: (Corporate Seal)

SURETY

Company: (Corporate Seal)

Signature:

Name and « »

Title:

(Any additional signatures appear on the last page of this Payment Bond.)

Signature:

Name and « »

Title:

(FOR INFORMATION ONLY — Name, address and telephone)

AGENT or BROKER:

« »
« »
« »

OWNER'S REPRESENTATIVE:

(Architect, Engineer or other party:)

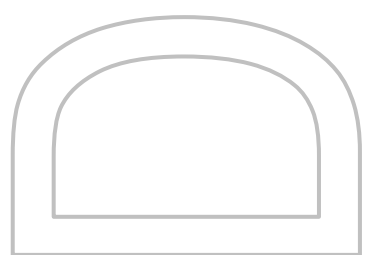
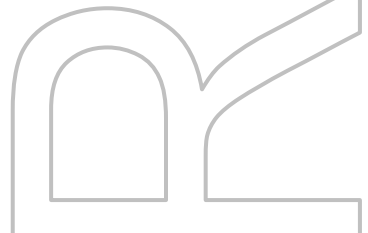
«Bruce Tarbox»
«Cumberland County Courthouse
142 Federal St
Portland, ME 04101-4169»
« »
« »
« »
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ADDITIONS AND DELETIONS:

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.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.



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§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner to pay for labor, materials and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

§ 2 If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies and holds harmless the Owner from claims, demands, liens or suits by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

§ 3 If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Section 13) of claims, demands, liens or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract and tendered defense of such claims, demands, liens or suits to the Contractor and the Surety.

§ 4 When the Owner has satisfied the conditions in Section 3, the Surety shall promptly and at the Surety's expense defend, indemnify and hold harmless the Owner against a duly tendered claim, demand, lien or suit.

§ 5 The Surety's obligations to a Claimant under this Bond shall arise after the following:

§ 5.1 Claimants, who do not have a direct contract with the Contractor,

- .1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and
- .2 have sent a Claim to the Surety (at the address described in Section 13).

§ 5.2 Claimants, who are employed by or have a direct contract with the Contractor, have sent a Claim to the Surety (at the address described in Section 13).

§ 6 If a notice of non-payment required by Section 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Section 5.1.1.

§ 7 When a Claimant has satisfied the conditions of Sections 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:

§ 7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

§ 7.2 Pay or arrange for payment of any undisputed amounts.

§ 7.3 The Surety's failure to discharge its obligations under Section 7.1 or Section 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Section 7.1 or Section 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

§ 8 The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Section 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

§ 9 Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

§ 10 The Surety shall not be liable to the Owner, Claimants or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to, or give notice on behalf of, Claimants or otherwise have any obligations to Claimants under this Bond.

§ 11 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 12 No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Section 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 13 Notice and Claims to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.

§ 14 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 15 Upon request by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

§ 16 Definitions

§ 16.1 Claim. A written statement by the Claimant including at a minimum:

- .1 the name of the Claimant;
- .2 the name of the person for whom the labor was done, or materials or equipment furnished;
- .3 a copy of the agreement or purchase order pursuant to which labor, materials or equipment was furnished for use in the performance of the Construction Contract;
- .4 a brief description of the labor, materials or equipment furnished;
- .5 the date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
- .6 the total amount earned by the Claimant for labor, materials or equipment furnished as of the date of the Claim;
- .7 the total amount of previous payments received by the Claimant; and
- .8 the total amount due and unpaid to the Claimant for labor, materials or equipment furnished as of the date of the Claim.

§ 16.2 Claimant. An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials or equipment were furnished.

§ 16.3 Construction Contract. The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

§ 16.4 Owner Default. Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 16.5 Contract Documents. All the documents that comprise the agreement between the Owner and Contractor.

§ 17 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

§ 18 Modifications to this bond are as follows:

« »

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL

Company:

(Corporate Seal)

SURETY

Company:

(Corporate Seal)

Signature:

Name and Title:

« »« »

Address:

« »

Signature:

Name and Title:

« »« »

Address:

« »

DRAFT AIA[®] Document A312[™] - 2010

Performance Bond

CONTRACTOR:

(Name, legal status and address)

« »
« »

SURETY:

(Name, legal status and principal place of business)

« »
« »

OWNER:

(Name, legal status and address)

«Cumberland County Commissioners»
«Cumberland County Courthouse
142 Federal St
Portland, ME 04101-4169»

CONSTRUCTION CONTRACT

Date: « »

Amount: \$ «»

Description:

(Name and location)

«Air Conditioning and Heating Upgrades at the Cumberland County Courthouse»
«Portland, ME»

BOND

Date:

(Not earlier than Construction Contract Date)

« »

Amount: \$ « »

Modifications to this Bond: None See Section 16

CONTRACTOR AS PRINCIPAL

Company: (Corporate Seal)

SURETY

Company: (Corporate Seal)

Signature:

Name and Title: « »

Title:

(Any additional signatures appear on the last page of this Performance Bond.)

Signature:

Name and Title: « »

Title:

(FOR INFORMATION ONLY — Name, address and telephone)

AGENT or BROKER:

« »
« »
« »

OWNER'S REPRESENTATIVE:

(Architect, Engineer or other party:)

«Bruce Tarbox»
«Cumberland County Courthouse
142 Federal St
Portland, ME 04101-4169»
« »
« »
« »
« »

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.

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§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

§ 2 If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Section 3.

§ 3 If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after

- .1 the Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Section 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;
- .2 the Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and
- .3 the Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

§ 4 Failure on the part of the Owner to comply with the notice requirement in Section 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

§ 5 When the Owner has satisfied the conditions of Section 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

§ 5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

§ 5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

§ 5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Section 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

§ 5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances:

- .1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or
- .2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

§ 6 If the Surety does not proceed as provided in Section 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Section 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

§ 7 If the Surety elects to act under Section 5.1, 5.2 or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to

the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication, for

- .1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;
- .2 additional legal, design professional and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Section 5; and
- .3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

§ 8 If the Surety elects to act under Section 5.1, 5.3 or 5.4, the Surety's liability is limited to the amount of this Bond.

§ 9 The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors and assigns.

§ 10 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 11 Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 12 Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

§ 13 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 14 Definitions

§ 14.1 **Balance of the Contract Price.** The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

§ 14.2 **Construction Contract.** The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

§ 14.3 **Contractor Default.** Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

§ 14.4 **Owner Default.** Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 14.5 **Contract Documents.** All the documents that comprise the agreement between the Owner and Contractor.

§ 15 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

§ 16 Modifications to this bond are as follows:

<< >>

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL

Company:

(Corporate Seal)

Signature:

Name and Title:

Address:

<< >><< >>

<< >>

SURETY

Company:

(Corporate Seal)

Signature:

Name and Title:

Address:

<< >><< >>

<< >>

DRAFT AIA® Document A701™ - 1997

Instructions to Bidders

for the following PROJECT:

(Name and location or address)

«Air Conditioning and Heating Upgrades at the Cumberland County Courthouse»
«Portland, ME»

THE OWNER:

(Name, legal status and address)

«Cumberland County Commissioners»« »
«Cumberland County Courthouse
142 Federal St
Portland, ME 04101-4169»

THE ARCHITECT:

(Name, legal status and address)

«Allied Engineering, Inc.»« »
«160 Veranda St.
Portland, ME 04103»

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:

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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 in the number and for the deposit sum, if any, stated therein. The deposit will be refunded to Bidders who submit a bona fide Bid and return the Bidding Documents in good condition within ten days after receipt of Bids. The cost of replacement of missing or damaged documents will be deducted from the deposit. A Bidder receiving a Contract award may retain the Bidding Documents and the Bidder's deposit will be refunded.

§ 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.

§ 3.4 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.

ARTICLE 4 BIDDING PROCEDURES

§ 4.1 PREPARATION OF BIDS

§ 4.1.1 Bids shall be submitted 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.

§ 4.2 BID SECURITY

§ 4.2.1 Each Bid shall be accompanied by a bid security in the form and amount required if so stipulated in the Instructions to Bidders. The Bidder pledges to enter into a Contract with the Owner on the terms stated in the Bid and will, if required, furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Should the Bidder refuse to enter into such Contract or fail to furnish such bonds if required, the amount of the bid security shall be forfeited to the Owner as liquidated damages, not as a penalty. The amount of the bid security shall not be forfeited to the Owner in the event the Owner fails to comply with Section 6.2.

§ 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 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.

§ 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 during the stipulated time period 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 then 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 informalities 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 If stipulated in the Bidding Documents, the Bidder shall furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Bonds may be secured through the Bidder's usual sources.

§ 7.1.2 If the furnishing of such bonds is stipulated in the Bidding Documents, the cost shall be included in the Bid. If the furnishing of such bonds is required after receipt of bids and before execution of the Contract, the cost of such bonds shall be added to the Bid in determining the Contract Sum.

§ 7.1.3 If the Owner requires that bonds be secured from other than the Bidder's usual sources, changes in cost will be adjusted as provided in the Contract Documents.

§ 7.2 TIME OF DELIVERY AND FORM OF BONDS

§ 7.2.1 The Bidder shall deliver the required bonds to the Owner not later than three days following the date of execution of the Contract. If the Work is to be commenced prior thereto in response to a letter of intent, the Bidder shall, prior to commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished and delivered in accordance with this Section 7.2.1.

§ 7.2.2 Unless otherwise provided, the bonds shall be written on AIA Document A312, Performance Bond and Payment Bond. Both bonds shall be written in the amount of the Contract Sum.

§ 7.2.3 The bonds shall be dated on or after the date of the Contract.

§ 7.2.4 The Bidder shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of the power of attorney.

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.



State of Maine Judicial Branch
BACKGROUND INVESTIGATION INFORMATION

Instructions: You may complete this form electronically or by handwriting the information. If you complete it electronically, you must then print and sign the form. **An original signature is required.**

Acknowledgement: By completing and signing this document, I understand that to work in the Judicial Branch, a background investigation must be conducted by the Maine Judicial Branch Office of State Judicial Marshals. This background investigation will include, but is not limited to, an inquiry and documentation of any criminal conviction, arrest and conviction records, also any motor vehicle offense or convictions. I understand that my status as an applicant with the Judicial Branch is contingent on the results of this investigation. I hereby consent to a background investigation and give permission to the Office of State Judicial Marshals to examine any criminal and motor vehicle arrest and conviction records, or other regulatory agency records that pertain to me.

Have you ever been convicted of any criminal offense, not including non-criminal traffic offenses? No ____ Yes ____
If yes, Please explain:

Name: (please print) <small>Full name:</small>	(First)	(Middle)	(Last)
Maiden or previous names used: (list all)			
Date of birth:	Social Security Number:		
Current driver's license number:	State:		
Prior state driver's license number:	State:		
Current Address:	(Street)	(City)	(State) (Zip)
From:	To: Present:		
I have lived at this address for the past 10 years or more. No ____ Yes ____ If no, see page 2 for additional information.			

I declare that the information provided herein is true, accurate, and complete to the best of my knowledge.

 Signature of Applicant Date

Administrative Section

For internal Judicial Branch use only:

Print name of HR Rep/Program Mgr.

Signature Office Date

Investigation for HR Department: Employee ____ Volunteer ____ Manpower ____ Contractor ____ Intern ____
 Extern ____ Law Clerk ____

Supervisor: _____ Location: _____

Investigation for Program Manager: LEP ____ CADRES ____ CASA ____ GALS ____ FDP ____ Bail Commissioner ____

Supervisor: _____ Location: _____

BACKGROUND INVESTIGATION INFORMATION

Pleas list your former addresses and dates at those addresses for the **past full 10 years**, including temporary addresses, such as college dormitories, etc. If you do not know the exact dates, give an approximate date. Be sure to include the full address – street, city , State, and zip code.

This section must be complete or your application cannot be processed.

Former address 1:			
From:		To:	
Former address 2:			
From:		To:	
Former address 3:			
From:		To:	
Former address 4:			
From:		To:	
Former address 5:			
From:		To:	
Former address 6:			
From:		To:	
Former address 7:			
From		To:	
Former address 8:			
From:		To:	
Former address 9:			
From		To:	
Former address 10:			
From		To:	

AIR CONDITIONING AND HEATING UPGRADES
CUMBERLAND COUNTY COURTHOUSE
PORTLAND, MAINE
ISSUED FOR BID
DECEMBER 22, 2017

SECTION 001113 - ADVERTISEMENT FOR BIDS

- A. Notice to Bidders:
 - 1. Sealed proposals, in envelopes plainly marked: Proposal for Air Conditioning and Heating Upgrades at the Cumberland County Courthouse as shown on contract drawings.
 - 2. Owner's Representative: Bruce Tarbox, Facilities Manager

- B. Project Description: Project consists of:
 - 1. Expansion for the water cooled VRV system at the County Side of the Cumberland County Courthouse in Portland, Maine for added heat and air conditioning at Courtroom #12, the second floor Southeast Conference Room and Supreme Court Justice suite, the first floor Conference Room, East Offices at the First Floor, First Floor IT Room, North Probate Court Suite, and other Work indicated in the Contract Documents.

- C. Cumberland county commissioners will receive sealed lump sum bids until the bid time and date at the location given below.
 - 1. Bid Date: January 18, 2018, at 2:00 p.m., local time. Bids will be thereafter publicly opened and read aloud.
 - 2. Location: Conference Room B, 142 Federal Street, Portland, ME 04101-4196.
 - 3. Bids received after 2:00 PM will be returned unopened.

- D. Bid security shall be submitted with each bid in the amount of 5 (Five) percent of the bid amount. No bids may be withdrawn for a period of 30 thirty days after opening of bids. Owner reserves the right to reject any and all bids and to waive informalities and irregularities.

- E. Prebid Meeting: A mandatory prebid meeting for bidders will be held at Conference Room B, 142 Federal Street, Portland, ME on January 10, 2018 at 10:00 a.m., local time.

- F. Printed Contract Documents: Obtain after December 22, 2017 by contacting:
 - Xpress Copy
 - 100 Fore Street
 - Portland, ME 04101

- G. Only complete sets of documents will be issued: For a non-refundable fee of \$95.00 for hard sets and \$50.00 for electronic sets, made payable to Xpress Copy.

- H. Successful bidder shall begin the Work on receipt of the Notice to Proceed and shall complete the Work within the Contract Time.

- I. Bidders must be properly licensed under the laws governing their respective trades and be able to obtain insurance required for the Work as specified in AIA Document A107-2007.

The Cumberland County Commissioners reserve the right to accept or reject any and all bids and, at their discretion, to waive all formalities.

00 11 13 - Notice to Bidders

A. Project Identification: **Air Conditioning and Heating Upgrades at the Cumberland County Courthouse**

1. Project Location: Cumberland County Courthouse, 205 Newbury Street, Portland Maine.

B. Owner: Cumberland County Commissioners.

1. Owner's Representative:

Bruce Tarbox, Facilities Engineer
Cumberland County Courthouse
Facilities Department
142 Federal Street
Portland, Maine 04101.

2. Engineer: Allied Engineering, Inc. 160 Veranda Street, Portland, ME 04103.

C. **WORK COVERED BY CONTRACT DOCUMENTS** - The Work of Project is defined by the Contract Documents and consists of, but is not specifically limited to the following scope summary:

1. Expansion for the water cooled VRV system at the County Side of the Cumberland County Courthouse in Portland, Maine for added heat and air conditioning at Courtroom #12, the second floor Southeast Conference Room and Supreme Court Justice suite, the first floor Conference Room, East Offices at the First Floor, First Floor IT Room, North Probate Court Suite, and other Work indicated in the Contract Documents.

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

E. The cost of the work is approximately \$500,000. The work to be performed under this contract shall be completed on or before June 01, 2018, except as follows:

- Work associated with the heating and air conditioning upgrades in Courtroom #12, including the installation of the new cooling tower, for a complete, functioning system, shall be substantially complete on April 20, 2018.

1. Sealed Contractor bids for the project noted above, in envelopes plainly marked "Air Conditioning and Heating Upgrades" and addressed to:

Bruce Tarbox, Facilities Engineer
Cumberland County Courthouse
Facilities Department
142 Federal Street
Portland, Maine 04101.

Will be due, opened and read aloud at **2:00PM on January 18, 2018**. Bids submitted after the noted time will not be considered and will be returned unopened.

2. The bid shall be submitted on the Contractor Bid Form (section 00 41 13) provided in the Bid Documents. The bid shall be awarded to the lowest bidder that meets the specifications and submits proper bond requirements. The low bidder will receive the award unless supporting information presented recommends another bid. The Board of Commissioners shall make the final decision if supporting information justifies other than the low bid be awarded.
3. Bid security is required on this project. The Bidder shall include a satisfactory Bid Bond (section 00 43 13) or a certified or cashier's check for 5% of the bid amount with the completed bid form submitted to the Owner.
4. Performance and Payment Bonds are required on this project. The selected Contractor shall furnish a 100% contract Performance Bond (section 00 61 13.13) and a 100 contract Payment Bond (section 00 61 13.16) in the contract amount to cover the execution of the Work.
5. Filed Sub-bids are not required on this project,
6. There are no Pre-qualified General Contractors on this project.
7. There will be a mandatory pre-bid conference for this project at **10:00 AM on January 10, 2018**.
 - a. Bidder wishing to visit the site may contact Bruce Tarbox at (207) 871-8293

End Notice to Contractors

Addendum No. _____ Dated: _____

7. Bid security *is required* on this project. The Bidder shall include a satisfactory Bid Bond (section 00 43 13) or a certified or cashier's check for 5% of the bid amount with this completed bid form submitted to the Owner.
8. Filed Sub-bids ***are not required*** on this project.
9. The Bidder agrees, if this bid is accepted by the Owner, to sign the designated Owner-Contractor contract and deliver it, with any and all bonds and affidavits of insurance specified in the Bid Documents, within twelve calendar days after the date of notification of such acceptance, except if the twelfth day falls on a State of Maine government holiday or other closure day, a Saturday, or a Sunday, in which case the aforementioned documents must be received before 12:00 noon on the day following the holiday or other closure day, Saturday or Sunday. As a guarantee thereof, the Bidder submits, together with this bid, a bid bond or other acceptable instrument as and if required by the Bid Documents.

This bid is hereby submitted by:

Signature: _____

Printed name and title: _____

Company name: _____

Mailing address: _____

City, state, zip code: _____

Phone number: _____

Email address: _____

State of incorporation, if a corporation: _____

List of all partners, if a partnership: _____

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Definitions

1. Definitions

- 1.1 *Addendum*: A document issued by the Architect that amends the Bid Documents. Addenda shall not be issued less than seventy-two hours prior to the specified bid opening time.
- 1.2 *Allowance*: A specified dollar amount for a particular scope of work or service included in the Work that is identified in the Bid Documents and included in each Bidder's Bid. The Contractor shall document expenditures for an Allowance during the Project. Any unused balance shall be credited to the Owner. The Contractor is responsible for notifying the Owner of anticipated expenses greater than the specified amount and the Owner is responsible for those additional expenses.
- 1.3 *Alternate Bid*: The Contractor's written offer of a specified dollar amount, submitted on the Bid Form, for the performance of a particular scope of work described in the Bid Documents. The Owner determines the low bidder based on the sum of the base Bid and any combination of Alternate Bids that the Owner selects.
- 1.4 *Architect*: The Architect or Engineer acting as Professional-of-Record for the project. The Architect is responsible for the design of the Project.
- 1.5 *Architectural Supplemental Instruction (ASI)*: A written instruction from the Architect for the purpose of clarification of the Contract Documents. An ASI does not alter the Contract Price or Contract Time. ASIs may be responses to RFIs and shall be issued by the Architect in a timely manner to avoid any negative impact on the Schedule of Work.
- 1.6 *Bid*: The Contractor's written offer of a specified dollar amount or amounts, submitted on a form included in the Bid Documents, for the performance of the Work. A Bid may include bonds or other requirements. A base Bid is separate and distinct from Alternate Bids, being the only cost component necessary for the award of the contract, and representing the minimum amount of Work that is essential for the functioning of the project.
- 1.7 *Bid Bond*: The security designated in the Bid Documents, furnished by Bidders as a guaranty of good faith to enter into a contract with the Owner, should a contract be awarded to that Bidder.
- 1.8 *Bidder*: Any business entity, individual or corporation that submits a bid for the performance of the work described in the Bid Documents, acting directly or through a duly authorized representative.
- 1.9 *Bid Documents*: The drawings, procurement and contracting requirements, general requirements, and the written specifications -including all addenda, that a bidder is required to reference in the submission of a bid.
- 1.10 *Bureau*: The State of Maine Bureau of General Services in the Department of Administrative and Financial Services.
- 1.11 *Calendar days*: Consecutive days, as occurring on a calendar, taking into account each day of the week, month, year, and any religious, national or local holidays.
- 1.12 *Certificate of Substantial Completion*: A document developed by the Architect that describes the final status of the Work and establishes the date that the Owner may use the facility for its intended purpose. The Certificate of Substantial Completion also include a provisional list of items (a "punch

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list") remaining to be corrected by the Contractor, if any, and identifies a date from which the project warranty period commences.

- 1.13 *Certificate of Occupancy*: A document developed by a local jurisdiction such as the Code Enforcement Officer that grants permission to the Owner to occupy a building.
- 1.14 *Change Order (CO)*: A document that modifies the contract and establishes the basis of a specific adjustment to the Contract Price or the Contract Time, or both. Change Orders may address correction of omissions, errors, and document discrepancies, or additional requirements. Change Orders should include all labor, materials and incidentals required to complete the work described. A Change Order is not valid until signed by the Contractor, Owner and Architect and approved by the Bureau.
- 1.15 *Change Order Proposal (COP)*: Change proposed by the Contractor in the contract amount, requirements, or time, which becomes a Change Order when approved by the Owner.
- 1.16 *Clerk of the Works*: The authorized representative of the Architect on the job site. Clerk of the Works is also called Architect's representative.
- 1.17 *Construction Change Directive (CCD)*: A written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to final agreement with the Contractor on adjustment, if any, in the Contract Price or Contract Time, or both.
- 1.18 *Contract*: A written agreement between the Owner and the successful bidder which obligates the Contractor to perform the work specified in the Contract Documents and obligates the Owner to compensate the Contractor at the mutually accepted sum, rates or prices.
- 1.19 *Contract Bonds (also known as Payment and Performance Bonds)*: The approved forms of security, furnished by the Contractor and their surety, which guarantee the faithful performance of all the terms of the contract and the payment of all bills for labor, materials and equipment by the Contractor.
- 1.20 *Contract Documents*: The drawings and written specifications (including all addenda), Standard General Conditions, and the contract (including all Change Orders subsequently incorporated in the documents).
- 1.21 *Contract Price*: The dollar amount of the construction contract, also called *Contract Sum*.
- 1.22 *Contract Time*: The designated duration of time to execute the Work of the contract, with a specific date for completion.
- 1.23 *Contractor*: Also called the "General Contractor" or "GC" the individual or entity undertaking the execution of the general contract work under the terms of the contract with the Owner, acting directly or through a duly authorized representative. The Contractor is responsible for the means, methods and materials utilized in the execution and completion of the Work.
- 1.24 *Drawings*: The graphic and pictorial portion of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

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- 1.25 *Filed Sub-bid*: The designated major Subcontractor's (or, in some cases, Contractor's) written offer of a specified dollar amount or amounts, submitted on a form included in the Bid Documents, for the performance of a particular portion of the Work. A Filed Sub-bid may include bonds or other requirements.
- 1.26 *Final Completion*: Project status indicating when the Work is fully completed in compliance with the Contract Documents. Final Completion is documented by a date on which the Contractor's obligations under the contract are complete and accepted by the Owner and final payment becomes due and payable.
- 1.27 *General Requirements*: The on-site overhead expense items the Contractor provides for the Project, typically including, but not limited to, building permits, construction supervision, Contract Bonds, insurance, field office, temporary utilities, rubbish removal, and site fencing. Overhead expenses of the Contractor's general operation are not included. Sometimes referred to as the Contractor's General Conditions.
- 1.28 *Owner*: The State agency which is represented by duly authorized individuals. The Owner is responsible for defining the scope of the Project and compensation to the Architect and Contractor.
- 1.29 *Owner's Representative*: The individual or entity contracted by the Owner to be an advisor and information conduit regarding the Project.
- 1.30 *Overhead*: General and administrative expenses of the Contractor's principal and branch offices, including payroll costs and other compensation of Contractor employees, deductibles paid on any insurance policy, charges against the Contractor for delinquent payments, and costs related to the correction of defective work, and the Contractor's capital expenses, including interest on capital used for the work.
- 1.31 *Performance and Payment Bonds (also known as Contract Bonds)*: The approved forms of security, furnished by the Contractor and their surety, which guarantee the faithful performance of all the terms of the contract and the payment of all bills for labor, materials and equipment by the Contractor.
- 1.32 *Post-Bid Addendum*: Document issued by the Architect that defines a potential Change Order prior to signing of the construction contract. The Post-Bid Addendum allows the Owner to negotiate contract changes with the Bidder submitting the lowest valid bid, only if the negotiated changes to the Bid Documents result in no change or no increase in the bid price.
- A Post-Bid Addendum may also be issued after a competitive construction Bid opening to those Bidders who submitted a Bid initially, for the purpose of rebidding the Project work without re-advertising.
- 1.33 *Project*: The construction project proposed by the Owner to be constructed according to the Contract Documents. The entire public improvement project may also include separate construction and other activities conducted by the Owner or other contractors. The Owner shall inform all contractors of the scope of the entire public improvement project relative to each individual contract.
- 1.34 *Proposal*: The Contractor's written offer submitted to the Owner for consideration containing a specified dollar amount or rate, for a specific scope of work, and including a schedule impact, if any.

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A proposal shall include all costs for overhead and profit. After acceptance by all parties a proposal amends the contract and is implemented by the Contractor.

- 1.35 *Proposal Request (PR)*: An Owner's written request to the Contractor for a Change Order Proposal.
- 1.36 *Punch List*: A document that identifies the items of work remaining to be done by the Contractor at the Close Out of a Project. The Punch List is created as a result of a final inspection of the work only after the Contractor attests that all of the Work is in its complete and permanent status.
- 1.37 *Request For Information (RFI)*: A Contractor's written request to the Architect for clarification, definition or description of the Work. RFIs shall be presented by the Contractor in a timely manner to avoid any negative impact on the Schedule of Work.
- 1.38 *Request For Proposal (RFP)*: An Owner's written request to the Contractor for a Change Order Proposal.
- 1.39 *Requisition for Payment*: The document in which the Contractor certifies that the Work described is, to the best of the Contractor's knowledge, information and belief, complete and that all previous payments have been paid by the Contractor to Subcontractors and suppliers, and that the current requested payment is now due. See *Schedule of Values*.
- 1.40 *Retainage*: The amount, calculated at five percent (5%) of the contract value or a scheduled value, that the Owner shall withhold from the Contractor until the work or portion of work is declared substantially complete or otherwise accepted by the Owner. The Owner may, if requested, reduce the amount withheld if the Owner deems it desirable and prudent to do so. (See Title 5 M.R.S.A., Section 1746.)
- 1.41 *Sample*: A physical example provided by the Contractor which illustrates materials, equipment or workmanship and establishes standards by which the Work will be judged.
- 1.42 *Schedule of the Work*: The document prepared by the Contractor and approved by the Owner that specifies the dates on which the Contractor plans to begin and complete various parts of the Work, including dates on which information and approvals are required from the Owner.
- 1.43 *Schedule of Values*: The document prepared by the Contractor and approved by the Owner before the commencement of the Work that specifies the dollar values of discrete portions of the Work equal in sum to the contract amount. The Schedule of Values is used to document progress payments of the Work in regular (usually monthly) requisitions for payment. See *Requisition for Payment*.
- 1.44 *Shop Drawings*: The drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.
- 1.45 *Specifications*: The portion of the Contract Documents consisting of the written requirements of the Work for materials, equipment, systems, standards, workmanship, and performance of related services.
- 1.46 *Subcontractor*: An individual or entity undertaking the execution of any part of the Work by virtue of a written agreement with the Contractor or any other Subcontractor. Also, an individual or entity

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retained by the Contractor or any other Subcontractor as an independent contractor to provide the labor, materials, equipment or services necessary to complete a specific portion of the Work.

- 1.47 *Substantial Completion*: Project status indicating when the Work or a designated portion of the Work is sufficiently complete in compliance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended purpose without unscheduled disruption. Substantial Completion is documented by the date of the Certificate of Substantial Completion signed by the Owner and the Contractor.
- 1.48 *Superintendent*: The representative of the Contractor on the job site, authorized by the Contractor to receive and fulfill instructions from the Architect.
- 1.49 *Surety*: The individual or entity that is legally bound with the Contractor and Subcontractor to insure the faithful performance of the contract and for the payment of the bills for labor, materials and equipment by the Contractor and Subcontractors.
- 1.50 *Work*: The construction and services, whether completed or partially completed, including all labor, materials, equipment and services provided or to be provided by the Contractor and Subcontractors to fulfill the requirements of the Project as described in the Contract Documents.

AIR CONDITIONING AND HEATING UPGRADES
CUMBERLAND COUNTY COURTHOUSE
PORTLAND, MAINE
ISSUED FOR BID
DECEMBER 22, 2017

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Project information.
- 2. Work covered by Contract Documents.
- 3. Access to site.
- 4. Coordination with occupants.
- 5. Work restrictions.
- 6. Specification and Drawing conventions.
- 7. Miscellaneous provisions.

B. Related Requirements:

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

1.3 PROJECT INFORMATION

- A. Project Identification: Air Conditioning and Heating Upgrades at the Cumberland County Courthouse.

- 1. Project Location: Cumberland County Courthouse, Portland, Maine.

- B. Owner: Cumberland County Commissioners.
Owner's Representative: Bruce Tarbox, Facilities Engineer
Cumberland County Courthouse
Facilities Department
142 Federal Street, Portland, Maine 04101.

- C. Architect: Winton Scott Architects, 5 Milk Street, Portland, Maine 04101

- D. Engineer: Allied Engineering, Inc, 160 Veranda Street, Portland, Maine 04103.

AIR CONDITIONING AND HEATING UPGRADES
CUMBERLAND COUNTY COURTHOUSE
PORTLAND, MAINE
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1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
1. Expansion for the water cooled VRV system at the County Side of the Cumberland County Courthouse in Portland, Maine for added heat and air conditioning at Courtroom #12, the second floor Southeast Conference Room and Supreme Court Justice suite, the first floor Conference Room, East Offices at the First Floor, First Floor IT Room, North Probate Court Suite, and other Work indicated in the Contract Documents.
- B. Type of Contract:
1. Project will be constructed under a single prime contract.

1.5 ACCESS TO SITE

- A. Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
1. Limits: Confine construction operations to the roof, Attic, Third Floor Work Area, Second Floor Work Area, and First Floor Work Areas as outlined in the contract drawings.
 2. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- B. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- C. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.6 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy site and existing building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.

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1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

1.7 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
2. In the event that the contractor wish to shut down any portion of the public street or in any way impede access to adjacent facilities to facilitate rigging of equipment to the roof, the contractor shall strictly schedule this work with the City, the Owner, and Authorities Having Jurisdiction. It is preferable that such work, if required, be performed outside of normal working hours.
3. For access to facility parking areas for the purpose of rigging, coordinate these activities strictly with the owner.
4. **Prior to commencement of work in any area, the contractor shall be required to pass a Judicial Background test (Background Form 2013, attached), to be filled out and submitted one week prior to commencement of work at the site.**
5. **Work within the Second Floor Supreme Court Conference Room and Supreme Court Justice Suite (Alternate #3) shall require accompaniment by a Marshal. The contractor shall be required to submit a schedule for work within these areas so that the presence of a Marshal may be arranged.**

B. On-Site Work Hours: It is the intent that work in most areas of the project may be conducted during normal business hours, of 8:00 a.m. to 5:00 p.m., Monday through Friday, unless otherwise indicated. These areas include corridors, mechanical spaces, attic, and Administrative Areas. However, work in these areas shall be strictly scheduled with Cumberland County representatives to insure that occupants are not scheduled for simultaneous occupancy. Egress shall be strictly maintained within the corridor areas at all times. **The following exceptions to normal work hours applies:**

- **All work in the Probate Court area (Alternate #1) shall be conducted outside of normal business hours.**
- **There shall be no work within Courtroom #12 and the Supreme Court Conference Room and Justice Suite on February 02, February 12-15, March 06, March 07, March 23, April 10, April 11, and April 12 (all 2018). The contractor shall be responsible for**

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leaving all spaces associated with these areas in fully functional and operating condition prior to the dates listed.

- **No work shall be conducted within the Grand Jury Courtroom on third floor (Alternate #3) during the first calendar week of any month. The courtroom shall be available for owner occupancy, in fully functional condition, during those weeks.**

- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
 - 1. Notify Owner not less than two days in advance of proposed disruptive operations.
 - 2. Obtain Owner's written permission before proceeding with disruptive operations.
 - 3. Schedule such activities to occur outside of normal working hours.
- E. Dust Control: Erect temporary partitions and plastic sheeting as required to prevent the migration of dust and construction debris to occupied areas of the facility during construction.
- F. Restricted Substances: Use of tobacco products and other controlled substances on Project site is not permitted.
- G. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
 - 1. Maintain list of approved screened personnel with Owner's representative.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

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- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

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

1.4 PROCEDURES

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

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Alternate No. 1: Heating and Air Conditioning upgrades at the Probate Court Suite at the First Floor area.
 - 1. Base Bid: No work in this area.
 - 2. Alternate: Furnish and install HP-16, HP-17, HP-18, ERU-5, BS-7, and CD-4 with all associated piping, ductwork, electrical, controls, and architectural requirements to add air conditioning and heating upgrades to the Probate Court Suite.

- B. Alternate No. 2: Heating and Air Conditioning at the first floor Deeds Office.
 - 1. Base Bid: No work in this area.
 - 2. Alternate: Furnish and install HP-25 with all associated piping, ductwork, electrical, controls, and architectural requirements to add air conditioning and heating upgrades to the first floor Deeds Office.

- C. Alternate No. 3: Heating and Air Conditioning Upgrades at the second floor Conference Room and Supreme Court Justice Suite
 - 1. Base Bid: No work in this area.
 - 2. Alternate: Furnish and install HP-22, HP-23, HP-24, ERU-7, BS-11, and CD-6 with all associated piping, ductwork, electrical, controls, and architectural requirements to add air conditioning and heating upgrades to the second floor Conference Room and Supreme Court Justice suite.

- D. Alternate No. 4: Replace first floor corridor suspended acoustical tile
 - 1. Base Bid: Remove and reinstall the suspended acoustical tile and grid within the first floor corridor to the extent necessary to complete the mechanical and electrical installation noted on the drawings. Note: for areas where the mechanical upgrades are included as alternates, the ceiling removal and replacement associated with those alternates shall be included in the appropriate alternate cost.
 - 2. Alternate: Furnish and install new suspended acoustical tile ceiling system throughout the first floor corridor as indicated on the architectural drawings.

END OF SECTION 01 23 00

SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 01 23 00 "Alternates" for products selected under an alternate.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use facsimile of form provided in Project Manual.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.

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- b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - j. Cost information, including a proposal of change, if any, in the Contract Sum.
 - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.7 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

- a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
- b. Substitution request is fully documented and properly submitted.
- c. Requested substitution will not adversely affect Contractor's construction schedule.
- d. Requested substitution has received necessary approvals of authorities having jurisdiction.
- e. Requested substitution is compatible with other portions of the Work.
- f. Requested substitution has been coordinated with other portions of the Work.
- g. Requested substitution provides specified warranty.
- h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

- B. Substitutions for Convenience: Not allowed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 01 25 00 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710.

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.

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- d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to Architect.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
- 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 4. Include costs of labor and supervision directly attributable to the change.
 - 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - 6. Comply with requirements in Section 01 25 00 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 - 7. Proposal Request Form: Use form acceptable to Architect.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

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1.7 WORK CHANGE DIRECTIVE

- A. Work Change Directive: Architect may issue a Work Change Directive on EJCDC Document C-940. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

- B. Documentation: Maintain detailed records on a time and material basis of work required by the Work Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 01 26 00 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Section 01 32 00 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

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1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's Project number.
 - d. Contractor's name and address.
 - e. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703.
3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.

5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
6. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.
7. Overhead Costs: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
8. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
9. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

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1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
 - 1. Other Application for Payment forms proposed by the Contractor shall be acceptable to Architect and Owner. Submit forms for approval with initial submittal of schedule of values.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 - 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 - 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 - 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
 - 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 - 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

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- F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Products list (preliminary if not final).
 5. Sustainable design action plans, including preliminary project materials cost data.
 6. Schedule of unit prices.
 7. Submittal schedule (preliminary if not final).
 8. List of Contractor's staff assignments.
 9. List of Contractor's principal consultants.
 10. Copies of building permits.
 11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 12. Initial progress report.
 13. Report of preconstruction conference.
 14. Certificates of insurance and insurance policies.
 15. Performance and payment bonds.
 16. Data needed to acquire Owner's insurance.
- I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

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1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706.
 5. AIA Document G706A.
 6. AIA Document G707.
 7. Evidence that claims have been settled.
 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

SECTION 013000 - ALTERATIONS GENERAL

1. GENERAL

1.01 GENERAL CONDITIONS: The General Conditions, Supplementary General Conditions and all Sections of Division 1 shall apply to each and every contract and contractor, person or persons supplying material, labor or entering into the work directly or indirectly.

1.02 DESCRIPTION:

- A. The work covered by all sections of specifications shall conform to the conditions of this Section.
- B. The phrase “match existing” shall mean the following: Where Contract Documents call for exact matching, match existing work exactly in quality and appearance. When Contract Documents do not call for exact matching, match existing work as nearly as possible, using normally available materials and workmanship. If normally available materials and workmanship do not approximate existing work notify Architect. If in the Architect’s judgment it is impossible to approximate existing work with normally available materials and workmanship, the Architect may issue suitable Change Orders. Changes imposing extra costs to the Contractor will not be ordered without the Contractor’s approval. Existing structures and materials are indicated “existing”.
- C. In general, structures and materials which are not indicated existing are included in the work.

2. PRODUCTS

2.01 GENERAL

- A. Materials used to replace, patch or repair existing exposed work shall match or be compatible with existing adjacent finished surfaces.
- B. Materials used for such replacement, patching and repairing shall be as specified in the applicable section of this specification and/or as indicated on the drawings, or as approved by the Architect.

3. EXECUTION

3.01 TEMPORARY PARTITIONS Construct necessary temporary dust proof partitions to isolate construction work from adjacent areas and remove partitions when work in area is completed.

3.02 CUTTING AND PATCHING

- A. Contractor shall do all demolition, cutting, altering, removing, replacing and patching as necessary for the performance of the contract. Unless otherwise provided by the draw-

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ings or specifications, no structural members shall be cut or altered without authorization of the Architect.

- B. Where any alteration or new work is indicated it will be required that the contractor perform all necessary cutting, patching, altering and rebuilding necessary to produce a complete, finished and operational element.
 - C. Work remaining in place which is damaged or defaced by reason of work done under this contract shall be restored equal to its condition at the time of the award of the contract.
 - D. Where existing work is removed, exposed surfaces shall be finished to match adjacent surfaces.
 - E. All disturbed plaster areas and all holes, cracks and loose plaster shall be patched to provide a smooth uniform and sound wall, matching existing surfaces. Plaster around ne openings in existing walls shall be cut back to firm bond and patched to match surrounding area. Materials for patching shall be similar to adjacent materials. Bonding agents shall be used as required to produce positive bond.
 - F. Contractor shall provide all necessary shoring and temporary supports required for proper support of existing and new work during execution of the contract and shall remove same when support is no longer required.
- 3.03 COOPERATION: The Owner shall have the right, at any time during the construction of the structure, to enter the same for the purpose of installing any necessary work, or for any other purpose in connection with the installation of facilities, it being mutually understood and agreed, however, that the Contractor and the Owner will labor to mutual advantage where their several works in the above mentioned or unforeseen instances touch upon or interfere with each other.
- 3.04 SALVAGE All materials which are removed will become the property of the Contractor and shall be removed from the premises, unless indicated otherwise on the drawings or in these specifications.

END OF SECTION 013000

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Digital project management procedures.
 - 5. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
 - 1. Section 01 73 00 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

1.3 DEFINITIONS

- A. BIM: Building Information Modeling.
- B. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.

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2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in project meeting room. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its own operations with operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

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

1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

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- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 3. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 4. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 5. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 6. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor-control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 7. Review: Architect will review coordination drawings to confirm that in general the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
 8. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01 33 00 "Submittal Procedures."
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 2. File Preparation Format: DWG, operating in Microsoft Windows operating system.
 3. File Submittal Format: Submit or post coordination drawing files using PDF format.

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4. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.

1.7 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 1. Project name.
 2. Project number.
 3. Date.
 4. Name of Contractor.
 5. Name of Architect.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: AIA Document G716.
 1. Attachments shall be electronic files in PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

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1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 26 00 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- E. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

1.8 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of 10 working days prior to meeting.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
1. Attendees: Authorized representatives of Owner Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

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2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Use of web-based Project software.
 - h. Procedures for processing field decisions and Change Orders.
 - i. Procedures for RFIs.
 - j. Procedures for testing and inspecting.
 - k. Procedures for processing Applications for Payment.
 - l. Distribution of the Contract Documents.
 - m. Submittal procedures.
 - n. Sustainable design requirements.
 - o. Preparation of Record Documents.
 - p. Use of the premises and existing building.
 - q. Work restrictions.
 - r. Working hours.
 - s. Owner's occupancy requirements.
 - t. Responsibility for temporary facilities and controls.
 - u. Procedures for moisture and mold control.
 - v. Procedures for disruptions and shutdowns.
 - w. Construction waste management and recycling.
 - x. Parking availability.
 - y. Office, work, and storage areas.
 - z. Equipment deliveries and priorities.
 - aa. First aid.
 - bb. Security.
 - cc. Progress cleaning.
3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Progress Meetings: Conduct progress meetings at monthly intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

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- a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Status of sustainable design documentation.
 - 6) Deliveries.
 - 7) Off-site fabrication.
 - 8) Access.
 - 9) Site use.
 - 10) Temporary facilities and controls.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) Status of RFIs.
 - 16) Status of Proposal Requests.
 - 17) Pending changes.
 - 18) Status of Change Orders.
 - 19) Pending claims and disputes.
 - 20) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
- a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Submittal schedule requirements.
- 2. Administrative and procedural requirements for submittals.

B. Related Requirements:

- 1. Section 01 29 00 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
- 2. Section 01 31 00 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
- 3. Section 01 32 00 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
- 4. Section 01 40 00 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
- 5. Section 01 77 00 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
- 6. Section 01 78 23 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
- 7. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
- 8. Section 01 79 00 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

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

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requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.4 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
 4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal Category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's final release or approval.
 - g. Scheduled dates for purchasing.
 - h. Scheduled date of fabrication.
 - i. Scheduled dates for installation.
 - j. Activity or event number.

1.5 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
1. Project name.
 2. Date.
 3. Name of Architect.
 4. Name of Construction Manager.
 5. Name of Contractor.
 6. Name of firm or entity that prepared submittal.

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7. Names of subcontractor, manufacturer, and supplier.
8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
9. Category and type of submittal.
10. Submittal purpose and description.
11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
12. Drawing number and detail references, as appropriate.
13. Indication of full or partial submittal.
14. Location(s) where product is to be installed, as appropriate.
15. Other necessary identification.
16. Remarks.
17. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.6 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package, and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
 - a. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.

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4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
 - C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 1. Initial Review: Allow 7 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 7 days for review of each resubmittal.
 - D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
 - E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
 - F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.
- 1.7 SUBMITTAL REQUIREMENTS
- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.

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- d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
- C. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
- D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- E. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

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F. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

G. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.

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- d. Product and manufacturers' names.
- e. Description of product.
- f. Test procedures and results.
- g. Limitations of use.

1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 - 1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return it.
 - 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 33 00

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Owner will pay sewer-service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Owner will pay water-service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Owner will pay electric-power-service use charges for electricity used by all entities for construction operations.
- E. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- F. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

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1.4 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- D. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold.
- E. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:
 - 1. Locations of dust-control partitions at each phase of work.
 - 2. HVAC system isolation schematic drawing.
 - 3. Location of proposed air-filtration system discharge.
 - 4. Waste-handling procedures.
 - 5. Other dust-control measures.

1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

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

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PART 2 - PRODUCTS

2.1 MATERIALS

- A. Polyethylene Sheet: Reinforced, fire-resistive sheet, **10-mil (0.25-mm)** minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.
- B. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats minimum **36 by 60 inches (914 by 1524 mm)**.
- C. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

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

3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
 - 1. Locate facilities to limit site disturbance as specified in Section 01 10 00 "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

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3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
 - 1. Toilets: Use of Owner's existing toilet 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.
- D. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
 - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 - 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
 - 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.
- E. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- F. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

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3.4 SUPPORT FACILITIES INSTALLATION

- A. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
 - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- B. Existing Elevator Use: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.
 - 1. Do not load elevators beyond their rated weight capacity.
 - 2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.
- C. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided 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 stairs become damaged, restore damaged areas so no evidence remains of correction work.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
 - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Comply with work restrictions specified in Section 01 10 00 "Summary."
- C. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.

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1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
 2. Construct dustproof partitions with two layers of 6-mil (0.14-mm) polyethylene sheet on each side. Cover floor with two layers of 6-mil (0.14-mm) polyethylene sheet, extending sheets 18 inches (460 mm) up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.
 - a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches (1219 mm) between doors. Maintain water-dampened foot mats in vestibule.
 3. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
 4. Insulate partitions to control noise transmission to occupied areas.
 5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 6. Protect air-handling equipment.
 7. Provide walk-off mats at each entrance through temporary partition.
- D. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

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- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00 "Closeout Procedures."

END OF SECTION 01 50 00

SECTION 017310 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. Related Sections include the following:
 - 1. Division 1 Section "Selective Demolition" for demolition of selected portions of the building for alterations.
 - 2. Divisions 2 through 16 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
 - a. Requirements in this Section apply to mechanical and electrical installations. Refer to Divisions 22, 23 & 26 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.3 DEFINITIONS

- A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
 - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
 - 2. Changes to Existing Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.

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3. Products: List products to be used and firms or entities that will perform the Work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.
6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
7. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 1. Primary operational systems and equipment.
 2. Air or smoke barriers.
 3. Fire-protection systems.
 4. Control systems.
 5. Communication systems.
 6. Conveying systems.
 7. Electrical wiring systems.
 8. Operating systems of special construction in Division 13 Sections.
- C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 1. Water, moisture, or vapor barriers.
 2. Membranes and flashings.
 3. Exterior curtain-wall construction.
 4. Equipment supports.
 5. Piping, ductwork, vessels, and equipment.
 6. Noise- and vibration-control elements and systems.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

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1. If possible, retain original Installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm.
 - a. Processed concrete finishes.
 - b. Stonework and stone masonry.
 - c. Ornamental metal.
 - d. Matched-veneer woodwork.
 - e. Preformed metal panels.
 - f. Roofing.
 - g. Firestopping.
 - h. Window wall system.
 - i. Stucco and ornamental plaster.
 - j. Terrazzo.
 - k. Finished wood flooring.
 - l. Fluid-applied flooring.
 - m. Aggregate wall coating.
 - n. Wall covering.
 - o. HVAC enclosures, cabinets, or covers.

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

- F. Prevent movement or settlement of adjacent elements of construction. Provide and place bracing or shoring and be responsible for safety and support of structure. Be liable for any such movement or settlement and any damage or injury caused.

1.6 WARRANTY

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

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections of these Specifications.
- B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to minimize interruption of services to occupied areas.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

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2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
- D. Cease operations and notify the Architect immediately, if safety of structure appears to be endangered. Take all precautions to properly support structure. Do not resume operations until permission is granted by the Architect and authorities having jurisdiction.

END OF SECTION 017310

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.
- B. Related Requirements:
 - 1. Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

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- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit by uploading to web-based project software site. Enable reviewer comments on draft submittals.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.
- E. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 **FORMAT OF OPERATION AND MAINTENANCE MANUALS**

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

1.6 **SYSTEMS AND EQUIPMENT OPERATION MANUALS**

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

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- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- D. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

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1.7 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.

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5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.
- J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
1. Do not use original project record documents as part of maintenance manuals.
- 1.8 PRODUCT MAINTENANCE MANUALS
- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
 - B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
 - C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

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- D. Product Information: Include the following, as applicable:
1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 23

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
1. Record Drawings.
 2. Record Specifications.
 3. Record Product Data.
 4. Miscellaneous record submittals.
- B. Related Requirements:
1. Section 01 77 00 "Closeout Procedures" for general closeout procedures.
 2. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
1. Number of Copies: Submit one set(s) of marked-up record prints.
 2. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record prints and one of file prints.
 - 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit record digital data file.
 - 2) Plot each drawing file, whether or not changes and additional information were recorded.

1.4 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

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1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 4. Refer instances of uncertainty to Architect for resolution.
 5. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 01 31 00 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 01 78 39

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
 - 2. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Attendance Record: For each training module, submit list of participants and length of instruction time.
- C. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

- 1. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
- 2. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to

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corresponding training components. Include name of Project and date of video recording on each page.

3. At completion of training, submit complete training manual(s) for Owner's use prepared in same PDF file format required for operation and maintenance manuals specified in Section 01 78 23 "Operation and Maintenance Data."

1.5 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.
- D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 1. Inspect and discuss locations and other facilities required for instruction.
 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 3. Review required content of instruction.
 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.7 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Systems and equipment operation manuals.
 - c. Systems and equipment maintenance manuals.
 - d. Product maintenance manuals.
 - e. Project Record Documents.
 - f. Identification systems.
 - g. Warranties and bonds.
 - h. 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.

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- 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.

1.8 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 78 23 "Operation and Maintenance Data."

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- B. Set up instructional equipment at instruction location.

1.9 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 - 2. Owner will furnish an instructor to describe Owner's operational philosophy.
 - 3. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- F. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 01 79 00

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of selected portions of a building.
 - 2. Patching and repairs.

1.2 DEFINITIONS

- A. Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the Owner's property.
- B. Remove and Salvage: Detach items from existing construction and deliver them to Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 PERFORMANCE REQUIREMENTS

- A. Design, furnish, install, monitor, and maintain temporary shoring, support and protection systems capable of supporting existing structure and construction loads.
 - 1. Provide professional engineering services needed to assume engineering responsibility, including preparation of Shop Drawings and a comprehensive engineering analysis by a qualified professional engineer.
 - 2. Install temporary shoring, support and protection systems without damaging existing buildings, pavements, and other improvements adjacent to demolition area.

1.4 SUBMITTALS

- A. Shop Drawings for Information: Prepared by or under the supervision of a qualified professional engineer for temporary shoring, support and protection systems.
 - 1. Include Shop Drawings signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Proposed Dust-Control and Noise-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.
- C. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.

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5. Detailed sequence of selective demolition and removal work to ensure uninterrupted progress of Owner's on-site operations.
6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
7. Locations of temporary partitions and means of egress.

1.5 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before starting selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to selective demolition including, but not limited to, the following:
 1. Inspect and discuss condition of construction to be selectively demolished.
 2. Review structural load limitations of existing structure.
 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.

1.6 PROJECT CONDITIONS

- A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials:
 1. Hazardous materials will be removed by Owner before start of the Work.
 2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.
- D. Storage or sale of removed items or materials on-site is not permitted.
- E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 1. Maintain fire-protection facilities in service during selective demolition operations.

1.7 WARRANTY

- A. Existing Special Warranty: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with the intended function or design are encountered, investigate and measure the nature and extent of the conflict. Promptly submit a written report to the Architect.
- E. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES

- A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
 - 1. Comply with requirements for existing services/systems interruptions specified in Division 1 Section "Summary."
 - 2. Provide not less than 72 hours' notice to Owner if shutdown of service is required during changeover.
- B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated utilities when requested by Contractor.
 - 2. Arrange to shut off indicated utilities with utility companies.
 - 3. Where utility services are required to be removed, relocated, or abandoned, provide bypass connections to maintain continuity of service to other parts of the building before proceeding with selective demolition.
 - 4. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit after bypassing.
 - a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Comply with requirements for access and protection specified in Division 1 Section "Temporary Facilities and Controls."

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

- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

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

- B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable,

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protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Cut concrete to a depth of at least **3/4 inch (19 mm)** at junctures with construction to remain, using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.
 - 1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.
- F. Roofing: Remove no more existing roofing than can be covered in one day by new roofing and so that building interior remains watertight and weathertight. Refer to Division 7 Sections for new roofing requirements.
 - 1. Remove existing roof membrane, flashings, copings, and roof accessories.
 - 2. Remove existing roofing metal edge flashings.
 - 3. Existing roofing wood nailers shall remain in place.
 - 4. Existing roof rigid insulation shall remain in place; remove insulation in designated areas only.
- G. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

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- D. Enter into a contract for the transportation and disposal of all solid waste in accordance with the applicable State, Local and Federal regulations.

3.7 CLEANING

- A. Sweep the building broom clean on completion of selective demolition operation.
- B. Change filters on air-handling equipment on completion of selective demolition operations.

END OF SECTION 024119

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Miscellaneous steel angles, plates, channels, and WF sections.
- B. Products furnished, but not installed, under this Section:
 - 1. Anchor bolts indicated to be cast into concrete or built into unit masonry.
- C. Related Sections:
 - 1. Division 5 Section "Pipe and Tube Railings."

1.3 SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details for metal fabrications.
 - 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- B. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

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1.5 PROJECT CONDITIONS

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

1.6 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages and angles for attachment to existing unit masonry or casting into concrete. Furnish setting drawings, templates, and directions for installing anchorages, including anchor bolts, and items with integral anchors, that are to be attached to unit masonry or embedded into concrete. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

- A. Structural Steel W (rolled wide flange) Shapes: As follows:
 - 1. High-Strength, Low-Alloy Columbium-Vanadium Steel: ASTM A 992, Grade 50.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Tubing: ASTM A 500, Grade B, cold-formed steel tubing.
- D. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.

2.3 FASTENERS

- A. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.

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- C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.
- D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Machine Screws: ASME B18.6.3.
- F. Lag Screws: ASME B18.2.1.
- G. Wood Screws: Flat head, ASME B18.6.1.
- H. Plain Washers: Square, ASTM F436.
- I. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- J. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds and repair painting galvanized steel, with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20
- D. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

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1. Available Products:
 - a. Five Star Grout by Five Star Products, Inc.
 - b. Masterflow 928 Grout by Master Builders Technologies.
 - c. SonogROUT 10K by Sonneborn.
 - d. 14K Hy Flow by Sonneborn.

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

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1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
- C. Galvanize miscellaneous framing and supports where indicated.

2.7 STEEL ANGLES

- A. Provide steel angles not specified in other Sections, for items supported from existing unit masonry or concrete construction, as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.8 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.
- C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.9 STEEL AND IRON FINISHES

- A. Galvanizing: Provide coating for iron and steel fabrications applied by the hot-dipped process, Durogalv by Duncan Galvanizing. The galvanizing bath shall contain high grade zinc and other earthy materials. Immediately before galvanizing, the steel shall be immersed in a bath of zinc ammonium chloride. The use of the wet kettle process is prohibited. Comply with ASTM A123 for fabricated products and ASTM A 153 for hardware. Provide thickness of galvanizing specified in referenced standards.

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- B. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

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3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 painting Sections.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 50 00

SECTION 05 52 13 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel pipe and tube railings.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 SUBMITTALS

- A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- B. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Welding certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

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1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls, rails, platforms and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ft., applied in any direction.
 - b. Concentrated load of 200 lbf., applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lbf., applied horizontally on an area of 1 sq. ft.
 - b. Infill load and other loads need not be assumed to act concurrently.

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.3 STEEL AND IRON

- A. Tubing: ASTM A 500 (cold formed).
- B. Pipe: ASTM A 53/A 53M, Grade B, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 1. Provide galvanized finish for exterior installations and where indicated.
- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.4 FASTENERS

- A. General: Provide the following:
 - 1. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
 - 2. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
 - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- ~~B.~~ Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds and repair painting galvanized steel, with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20
- C. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

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2.6 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with either welded or nonwelded connections, unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
 - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 - 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- J. Form Changes in Direction as Follows:
 - 1. By radius bends of radius required or by inserting prefabricated elbow fittings of radius required.
- K. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

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- L. Close exposed ends of railing members with prefabricated end fittings.
- M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
- N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- O. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.7 STEEL AND IRON FINISHES

- A. Galvanized Railings:
 - 1. Hot-dip galvanize steel railings, including hardware, after fabrication.
 - 2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
 - 3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
 - 4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
 - 5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine existing railing conditions to verify what pieces will remain, be removed and/or re-used. Indicate on shop drawing submittals, which existing railing pieces will remain, be re-used, or be removed.

3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

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1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

- A. Non-welded Connections: Use mechanical for permanently connecting railing components. S
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

3.4 ANCHORING POSTS

- A. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

3.5 ATTACHING RAILINGS

- A. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends or connected to railing ends using non-welded connections.

3.6 ADJUSTING AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

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3.7 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 05 52 13

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes, unless specified elsewhere, through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.
1. Provide one (1) hour rating for all wall penetrations.
 2. Provide two (2) hour rating for all attic floor penetrations.
 3. Provide two (2) hour rating for all penetrations not within masonry chases.
- B. Related Sections include the following:
1. Division 07 Section "Fire-Resistive Joint Systems."
 2. Division 21 Sections specifying fire-suppression piping penetrations.
 3. Division 22 and 23 Sections specifying duct and piping penetrations.
 4. Division 26, 27, and 28 Sections specifying cable and conduit penetrations.

1.3 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
- B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:
1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
 2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
 - a. Penetrations located outside wall cavities.

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- b. Penetrations located outside fire-resistance-rated shaft enclosures.
- 3. L-Rated Systems: Provide through-penetration firestop systems with L-ratings of not more than **3.0 cfm/sq. ft** at both ambient temperatures and **400 deg F**.
- C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
 - 1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
 - 2. For floor penetrations with annular spaces exceeding **4 inches** in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
 - 3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.
 - 1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
 - 2. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- C. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:
 - 1. Types of penetrating items.
 - 2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
 - 3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.

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- D. Qualification Data: For Installer.
- E. Product Certificates: For through-penetration firestop system products, signed by product manufacturer.
- F. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- B. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
 - 1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
 - 2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems complying with the following requirements:
 - a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
 - b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
- C. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
- D. Special Inspections: Allow for 1 of each type of firestopping system to be removed and inspected for conformance with approved submittals. All firestopping shall be inspected prior to the installation of ceilings.
- E. Above Ceiling review: Prior to the installation of ceilings, a review of construction completion shall be conducted for firestopping and other items that will not be visible when the ceilings have been installed.

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1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multi-component materials.
- B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.
- D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, through-penetration firestop systems that may be incorporated into the Work include those systems indicated that are produced by one of the following manufacturers:
 - 1. Grace, W. R. & Co. - Conn.
 - 2. Hilti, Inc.
 - 3. Nelson Firestop Products.

4. RectorSeal Corporation (The).
5. Specified Technologies Inc.
6. 3M; Fire Protection Products Division.
7. Tremco; Sealant/Weatherproofing Division.
8. USG Corporation.

2.2 FIRESTOPPING, GENERAL

- A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
- B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
 1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-/rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - c. Fire-rated form board.
 - d. Fillers for sealants.
 2. Temporary forming materials.
 3. Substrate primers.
 4. Collars.
 5. Steel sleeves.
- C. Maximum VOC Content: 250 g/l.

2.3 FILL MATERIALS

- A. General: Provide through-penetration firestop systems containing the types of fill materials as required by UL approved Through-Penetration Firestop System. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.
- B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- C. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

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- D. Elastomeric Spray: Single component, water-based elastomeric compound.
- E. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- F. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.
- G. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- H. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- I. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- J. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.
- K. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- L. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
 - 2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
 - 3. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.
- M. Unfaced, Slag-Wool-/Rock-Wool-Fiber Board Insulation: ASTM C 612, maximum flame-spread and smoke-developed indices of 15 and 0, respectively; passing ASTM E 136 for combustion characteristics; and of the following density, type, thermal resistivity, and fiber color:
 - 1. Nominal density of 4 lb/cu. ft., Types IA and IB, thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F.
 - 2. Color: Natural.
 - 3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fibrex Insulations Inc.
 - b. Owens Corning.

- c. Thermafiber.

2.4 MIXING

- A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for firestop systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Identify through-penetration firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within **6 inches** of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use mechanical fasteners for metal labels. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels:
 - 1. The words "Warning - Through-Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Through-penetration firestop system designation of applicable testing and inspecting agency.
 - 4. Date of installation.
 - 5. Through-penetration firestop system manufacturer's name.
 - 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.
- B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

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- C. Reinstall firestopping materials that have been removed for inspection.

3.6 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

SECTION 090320 - PATCHING OF HISTORIC PLASTER

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. Patching of wall and ceiling plaster at areas of new work.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

- 1. Review methods and procedures related to historic treatment of plaster including, but not limited to, the following:
 - a. Verify historic treatment specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
 - b. Materials, material application, colors, patterns, and sequencing.
 - c. Fire-protection plan.
 - d. Plasterwork historic treatment program.
 - e. Coordination with building occupants.

1.4 SEQUENCING AND SCHEDULING

- A. Perform historic treatment of plaster in the following sequence, which includes work specified in this and other Sections:
 - 1. Dismantle existing surface-mounted objects and hardware that overlie plaster surfaces except items indicated to remain in place. Tag items with location identification and protect.
 - 2. Verify that temporary protections have been installed.
 - 3. Examine condition of plaster surfaces.
 - 4. Clean plaster surface and remove paint and other finishes to the extent required.
 - 5. Repair and replace existing plaster and supports to the degree required for a uniform, tightly adhered surface on which to paint or apply other finishes.
 - 6. Cure repaired surfaces and allow them to dry for proper finishing.
 - 7. Paint and apply other finishes.
 - 8. Reinstall dismantled surface-mounted objects and hardware unless otherwise indicated.
- 5

1.5 QUALITY ASSURANCE

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- A. Historic Treatment Specialist Qualifications: A qualified plastering specialist with expertise in matching and performing the types of historic plasterwork repairs required.
- B. Plasterwork Historic Treatment Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be used for historic treatment work and protection of surrounding materials and Project site.
 - 1. If materials and methods other than those indicated are proposed for any phase of historic treatment work, add a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver packaged materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.
- B. Store materials on elevated platforms, under cover, and in a dry location with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
- C. Store hydrated lime and factory-prepared lime putty in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.
- D. Store materials not in use in tightly covered containers.
- E. Store lime putty covered with water in sealed containers.
- F. Store sand where grading and other required characteristics can be maintained and contamination avoided.
- G. Handle cast-plaster fabrications to prevent overstressing, chipping, defacement, and other damage.

1.7 FIELD CONDITIONS

- A. Comply with plaster-material manufacturers' written instructions.
- B. Temperatures: Maintain temperatures in work areas at not less than 55 deg F (13 deg C) or greater than 80 deg F (27 deg C) for at least seven days before application of plaster, continuously during application, and for seven days after plaster has set or until plaster has dried.
- C. Conditioning: Acclimatize cast-plaster fabrications to ambient temperature and humidity of spaces in which they are installed. Remove packaging and move units into installation spaces not less than 48 hours before installing them.
- D. Field Measurements: Where cast-plaster fabrications are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate

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measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work. E. Avoid conditions that result in plaster drying out too quickly.

1. Distribute heat evenly; prevent concentrated or uneven heat on plaster.
2. Maintain relative humidity levels for prevailing ambient temperature that produce normal drying conditions.
3. Ventilate work areas in a manner that prevents drafts of air from contacting surfaces during plaster application and until plaster is dry.

PART 2 - PRODUCTS

2.1 LIME-PLASTER MATERIALS

- A. Naturally Hydraulic Lime (NHL 2), EN-459 Standard, as provided by one of the following suppliers:
1. US Heritage Group (Otterbein from Germany) 773-286-2100,
 2. Limeworks US (St. Astier from France) 2215-536-6706,
 3. Historic Building Products (Singleton Birch from the UK) 416-645-0870.
- A. Sand Aggregates: ASTM C 897.
1. Finish-Coat Sand: Match size, texture, and gradation of existing sand as closely as possible. Blend several sands if necessary to achieve suitable match and wash to remove any clay content.
- B. Fabric Reinforcing: Coarse, open-weave, sackcloth made of natural linen, cotton, hemp, or jute; free of grease and oils; free of grease, waxes, and oils.

2.2 LATH

- A. Metal Lath:
1. Expanded-Metal Lath: ASTM C 847, cold-rolled carbon-steel sheet, ASTM A 653/A 653M, **G60 (Z180)**, hot-dip galvanized zinc coated.
 - a. Diamond-Mesh Lath: Self-furring, 3.4 lb/sq. yd. (1.8 kg/sq. m).

2.3 TRIM ACCESSORIES

- A. General: According to ASTM C 1063 for lime plaster; coordinate depth of trim and accessories with thicknesses and number of plaster coats required.
- B. Metal Accessories:
1. Striplath: Fabricated from expanded-metal lath with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.
 2. Cornerbeads: Fabricated from zinc or zinc-coated (galvanized) steel.
 - a. Small nose cornerbead with expanded flanges reinforced by perforated stiffening rib; use

on columns and for finishing unit masonry corners.

3. Casing Beads: Fabricated from zinc or zinc-coated (galvanized) steel; square-edged style; with expanded flanges.
4. Control Joints: Fabricated from zinc or zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.

2.4 MISCELLANEOUS MATERIALS

- A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.
- B. Fasteners for Attaching Lath to Substrates:
 1. For Lime Plaster: ASTM C 1063.
- C. Wire Ties: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch (1.21-mm) diameter, unless otherwise indicated.
- D. Plaster-Stabilization Materials: Acrylic emulsion(s) and related installation products shall have proven effectiveness in reattaching delaminated plaster and shall have been used previously by historic treatment specialist with successful results.
 1. Acrylic Emulsion(s), General: Aqueous emulsion(s) of acrylic polymer, adhesive to plaster and plaster substrates, nontoxic, and non-reemulsifiable after curing.
 2. Prewet Solution: Low-viscosity acrylic emulsion.
 3. Adhesive: Thickened acrylic emulsion; thickener as recommended in writing by resin manufacturer and historic treatment specialist.
- E. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:
 1. Previous effectiveness in performing the work involved.
 2. Little possibility of damaging exposed surfaces.
 3. Consistency of each application.
 4. Uniformity of the resulting overall appearance.
 5. Do not use products or tools that could do the following:
 - a. Remove, alter, or in any way harm the present condition or future preservation of existing surfaces, including surrounding surfaces not in contract.
 - b. Leave an unintended residue on surfaces.

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT OF PLASTER, GENERAL

- A. Historic Treatment Appearance Standard: Completed work is to have a uniform appearance as viewed by Architect from building interior at 5 feet (1.5 m) away from surface.

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- B. General: In treating historic plaster, disturb it as minimally as possible and as follows unless otherwise indicated:
 - 1. Dismantle loose, damaged, or deteriorated plaster, lath, and support systems that cannot be repaired.
 - 2. Verify extent of plaster deterioration against that indicated on Drawings. Consult Architect on types and extent of required work.
 - 3. Verify that substrate surface conditions are suitable for repairs.
 - 4. Provide lath, furring, and support systems for plaster included in the work of this Section.
 - 5. Replace lost details in new, wet-applied and cast plaster that replicate existing or indicated plaster configurations.
 - 6. Leave repaired plasterwork in proper condition for painting or applying other finishes as indicated.
 - 7. Install temporary protective measures to protect historic surfaces that shall be treated later.

- C. Illumination: Perform plastering work with adequate, uniform illumination that does not distort the flatness or curvature of surfaces.

3.2 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate and environmental conditions, installation tolerances, and other conditions affecting performance of the Work.
 - 1. If existing substrates cannot be prepared to an acceptable condition for plastering work, notify Architect in writing.
 - 2. Notify Architect of undocumented detrimental conditions including cracks, bulges, loose backup, rotted wood, rusted metal, and other deteriorated items.

- B. Masonry Substrates: Verify that mortar joints are struck flush. Notify Architect of undocumented masonry substrate without flush joints. Proceed with plastering as directed by Architect.

- C. Begin historic plastering work only after unsatisfactory conditions have been corrected.

3.3 PREPARATION FOR PLASTERING

- A. Substrates: Prepare according to plaster manufacturer's written instructions and as follows:
 - 1. Clean surfaces to remove dust, loose particles, grease, oil, incompatible curing compounds, form-release agents, and other foreign matter and deposits that could impair bond with plaster.
 - 2. Remove ridges and protrusions greater than 1/8 inch (3 mm) and fill depressions greater than 1/4 inch (6 mm) with patching material. Allow to set and dry.

3.4 PLASTER REMOVAL AND REPLACEMENT, GENERAL

- A. Dismantle plaster that is damaged or deteriorated to the limits indicated. Carefully dismantle areas along straight edges that lie over supports, without damaging surrounding plasterwork.

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- B. Maintain lath and supporting members in an undamaged condition so far as practicable. Dismantle damaged lath and supports that cannot be repaired or resecured and replace with new work of same type.
- C. Notify Architect of undocumented detrimental conditions including cracks, bulges, loose backup, rotted wood, rusted metal, and other deteriorated items.
- D. Do not deviate more than plus or minus 1/8 inch in 10 feet (3 mm in 3 m) from a true plane in finished plaster surfaces, as measured by a 10-foot (3-m) straightedge placed on surface.
- E. Clean substrate surfaces to remove grease, waxes, oils, waterborne staining, debris, and other foreign matter and deposits that could impair bond with repair material.
- F. Wet masonry and concrete bases before plaster application. Keep substrate damp to the touch but without visible water droplets.
- G. Wet remaining plaster abutting the replacement plaster before installing new plasterwork.
- H. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
- I. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

3.5 FLAT LIME-PLASTER REMOVAL AND REPLACEMENT

- A. General: Dismantle deteriorated plaster to existing sound plaster at locations indicated on Drawings.
 - 1. Inspect for wood lath deterioration. If any, replace lath with self-furring metal lath.
 - 2. Sand bonding surfaces of repair area, and clean the surface with a nonmetallic bristle brush.
 - 3. Wet substrate to damp condition, but without visible water droplets, then install new plaster to original profiles.
- B. Lime-Plaster Base Coats:
 - 1. Scratch Coat: 1 part lime putty, 2-1/2 parts base-coat sand.
 - 2. Brown Coat: 1 part lime putty, 3 parts base-coat sand.
- C. Lime-Plaster Finish Coats:
 - 1. Finish-Coat Mix for Smooth-Troweled Finish: 3 parts lime putty, 1 part finish-coat sand.
- D. Lime-Plaster Finishes: Match finish(es) of design reference sample(s).
 - 1. Provide smooth-troweled finish. Apply in one layer totaling 1/8 inch (3 mm) thick.
- E. Hairline cracking within the plaster or plaster separation at edge of a replacement is unacceptable. Completely dismantle such work and reinstall or repair as a crack repair.

3.6 REMOVING AND INSTALLING LATH AND ACCESSORIES

- A. General: Dismantle existing plaster as necessary to expose deteriorated or rusted lath, wire ties, and support system, back to firm substrates and supports. Repair with new materials, well secured to existing lath in good condition and to building structure.
 - 1. Cutting: Cut lath so it can be taken out completely from one support to the next. Cut to avoid cracking surrounding plaster.
 - 2. Cut out existing base-coat plaster beyond the edges of the new lath to permit new plaster to extend onto the old lath. Then step subsequent plaster coats to permit new plaster to extend over the old material.
 - 3. Fasten new lath to support system and to good existing lath. Wire tie at least every 6 inches (150 mm).
 - 4. Install new lath according to ASTM C 1063 for lime plaster.
- B. Notify Architect of undocumented detrimental conditions including cracks, bulges, loose backup, rotted wood, rusted metal, and other deteriorated items.
- C. Metal Lath: Install according to ASTM C 1063 for lime plaster.
 - 1. Vertical Furring: Install flat diamond-mesh lath.
 - 2. Flat-Ceiling and Horizontal Framing: Install flat diamond-mesh lath.
 - 3. Curved-Ceiling Framing: Install flat diamond-mesh lath.
 - 4. On Solid Surfaces, Not Otherwise Furred: Install self-furring, diamond-mesh lath.

3.7 PATCH-TYPE REPAIR

- A. General: Patch voids, fractured surfaces, and crushed areas in otherwise sound plaster that are larger than cracks at locations indicated on Drawings.
 - 1. Notify Architect of undocumented detrimental conditions including cracks, bulges, loose backup, rotted wood, rusted metal, and other deteriorated items.
 - 2. Inspect for deterioration of supporting plaster and lath, and repair or replace deteriorated material as required for a sound substrate.
 - 3. Rake perimeter of hole to sound plaster, and slightly undercut existing plaster to enable replacement plaster to tuck behind existing plaster.
 - 4. Replace missing lath in kind. Bridge gaps in wood lath with expanded-metal lath, overlapping wood by 6 inches (150 mm) and fastening them together.
 - 5. Clean hole to remove loose materials and other foreign matter and deposits that could impair bond with repair material. Where grease, waxes, oils, waterborne staining, or other foreign matter and deposits that could impair bond with repair material have penetrated into the plaster, enlarge the hole to remove these deposits.
 - 6. Wet substrate to damp condition, but without visible water droplets, then install patch material to original profiles.
 - 7. Maintain adjacent plasterwork in an undamaged condition so far as practicable.
- B. Lime-Plaster Mix: 1 part lime putty, 3 parts sand.
- C. Finishing: Finish flat surfaces flush and with same texture as adjacent existing plaster. For mold-

ed plaster shapes, tool surface to restore the sharp edges and the shape of the molded shape to original contours.

- D. Hairline cracking within the plaster or plaster separation at edge of a patch is unacceptable. Completely dismantle such work and reinstall or repair.

3.8 HAIRLINE CRACK REPAIR

- A. General: Repair cracks 1/16 inch (2mm) in width or narrower in otherwise sound plaster at locations indicated on Drawings.
 - 1. Notify Architect of undocumented detrimental conditions including cracks, bulges, loose backup, rotted wood, rusted metal, and other deteriorated items.
 - 2. Maintain adjacent plasterwork in an undamaged condition so far as practicable.
- B. Existing Topcoat: Open crack in existing topcoat to at least 1/8 inch (3 mm) in width and check for broken fiber reinforcement in base coats.
- C. Existing Base Coats: Do not open crack wider in existing base coats unless inspection or other indication shows that the fiber reinforcement has broken. Where inspections indicate failure of fiber reinforcement, proceed as for a large crack repair, but only for length of crack with broken fiber reinforcement.
- D. Clean out crack to remove loose materials and other foreign matter and deposits that could impair bond with repair material. Where grease, waxes, oils, waterborne staining, or other foreign matter and deposits that could impair bond with repair material have penetrated into the topcoat plaster, widen the crack and sand surface of the exposed basecoat to remove these deposits.
- E. Wet substrate to damp condition, but without visible water droplets.
- F. Force finish-coat plaster without aggregate into crack, filling crack to original plaster profile.
- G. Finishing: Finish flat surfaces flush and with same texture as adjacent existing plaster. For molded plaster shapes, tool surface to restore the sharp edges and the shape of the molded shape to original contours.

3.9 LARGE CRACK REPAIR

- A. General: Repair cracks over 1/16 inch (2 mm) in width in otherwise sound plaster at locations indicated on Drawings.
 - 1. Notify Architect of undocumented detrimental conditions including cracks, bulges, loose backup, rotted wood, rusted metal, and other deteriorated items.
 - 2. Maintain adjacent plasterwork in an undamaged condition so far as practicable.
- B. Open crack to at least 1/4 inch (6 mm) in width and full depth with V-groove tool, and check for bond separation or lath deterioration.

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- C. Abrade side surfaces of crack and remove inner crack debris by gouging (keying) the inside area of the crack.
- D. Clean out crack to remove loose materials and other foreign matter and deposits that could impair bond with repair material. Where grease, waxes, oils, waterborne staining, or other foreign matter and deposits that could impair bond with repair material have penetrated into the plaster, widen the crack to remove these deposits.
- E. Wet substrate to damp condition, but without visible water droplets.
- F. Install finish-coat plaster to fill crack to original plaster profile.
- G. Finishing: Finish flat surfaces flush and with same texture as adjacent existing plaster. For molded plaster shapes, tool surface to restore the sharp edges and the shape of the molded shape to original contours.
- H. Offset Cracks: If the crack is offset in surface plane by more than 1/8 inch (3 mm), dismantle the plaster on each side of the crack, a minimum width of 6 inches (150 mm) and down to the lath or other substrate. Then, repair as specified for flat-plaster removal and replacement.

3.10 REATTACHMENT OF DELAMINATED PLASTER

- A. General: Reattach plaster that has detached from its wooden lath.
 - 1. Notify Architect of undocumented detrimental conditions including cracks, bulges, loose backup, rotted wood, rusted metal, and other deteriorated items.
 - 2. Maintain adjacent plasterwork in an undamaged condition so far as practicable.
- B. Verify extent of detachment of plaster that has not yet fallen by tapping on plaster surface and evaluating the hollow or solid resonance.
- C. Protect floors from spillage and debris in the vicinity of work. Use materials resistant to the passage of fluids used in work.
- D. Drill 1/4-inch (6-mm) injection ports (holes) through the plaster spaced 3 to 6 inches (75 to 150 mm) apart over surface of detached plaster. Dislodge loose plaster particles, and vacuum debris from holes.
- E. Prewet injection ports, gaps at edges of lost plaster, back of plaster, and wooden lath with prewet solution.
- F. Inject adhesive into ports, enough to fill gaps between detached plaster and lath, and inject into gaps at edges of lost plaster.
- G. Clean off excess and smeared adhesive while wet.
- H. Apply temporary battens over surface of treated plaster to prevent further separation during repair work. Secure battens in place against plaster with screws through the battens and plaster and into

the wood lath.

- I. Maintain temporary battens in place for a week or more, allowing adhesive to coalesce and dry.
- J. Remove battens, patch holes and missing plaster, and repair cracks.

3.11 INSTALLATION TOLERANCES

- A. Completed plaster installation shall not deviate from a true plane by more than 1/8 inch (3 mm as measured by a 5-foot (1.5-m) straightedge placed at any location on a surface, except where existing plaster is retained as a substrate for new plasterwork.

3.12 CLEANING AND PROTECTION

- A. Protect work of other trades against damage. Promptly remove plaster from surfaces not indicated to be repaired or plastered. Do not scratch or damage finished surfaces.
- B. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.
- C. Correct damage to other historic surfaces and to new work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. Remove temporary protection and enclosure of other work.

END OF SECTION 090320

SECTION 095113 - ACOUSTICAL PANEL CEILINGS (ALTERNATE #4)

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. This Section includes acoustical panels and exposed suspension systems for ceilings.

1.3 DEFINITIONS

- A. AC: Articulation Class.
- B. CAC: Ceiling Attenuation Class.
- C. LR: Light Reflectance coefficient.
- D. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.

1.5 QUALITY ASSURANCE

- A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.
- B. Source Limitations:
 - 1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
 - 2. Suspension System: Obtain each type through one source from a single manufacturer.

1.6 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

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1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
 - b. Identify materials with appropriate markings of applicable testing and inspecting agency.
 2. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
 - a. Smoke-Developed Index: 450 or less.
- B. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with IBC.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
 - B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
 - C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.
- 1.8 PROJECT CONDITIONS
- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- 1.9 COORDINATION
- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.
- 1.10 EXTRA MATERIALS
- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

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1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.
3. Hold-Down Clips: Equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

- A. Recycled Content: Provide acoustical panels with recycled content such that postconsumer recycled content plus one-half of pre-consumer recycled content constitutes a minimum of 25 percent by weight.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E 795.
- C. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.
- D. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Where indicated, provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.2 ACOUSTICAL PANELS ACT-1

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 1. ACT-1: Certainteed; Symphony *m*, #1222BB-IOF-1 (For information only; tiles shall be furnished by the Owner)
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
 1. Type and Form: Type III, mineral base with painted finish; Form 1, nodular or 2, water felted.

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2. Pattern: CE (perforated, small holes and lightly textured) and I (embossed).
3. Color: White.
4. LR: Not less than 0.85.
5. NRC: Not less than 0.70.
6. CAC: Not less than 35.
7. Edge/Joint Detail: Beveled tegular edge.
8. Thickness: 3/4 inch.
9. Modular Size: 24 by 24 inches.
10. Antimicrobial Treatment: Broad spectrum fungicide and bactericide based

2.3 METAL SUSPENSION SYSTEMS, GENERAL

- A. Recycled Content: Provide products made from steel sheet with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- B. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- C. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
 1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- D. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- E. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than **0.106-inch-** diameter wire.
- F. Hanger Rods or Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- G. Angle Hangers: Angles with legs not less than **7/8 inch** wide; formed with **0.04-inch-** thick, galvanized steel sheet complying with ASTM A 653/A 653M, **G90** coating designation; with bolted connections and **5/16-inch-** diameter bolts.
- H. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced **24 inches** o.c. on all cross tees.
 1. Available Product: UHDC by Armstrong or L15 by USG.

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2.4 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
1. Main Runners : 1200 Series Seismic; Chicago Metallic.
 2. Balance of tees and perimeter moldings shall be furnished by the Owner.
- B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than **G30** coating designation, with prefinished **15/16-inch-** wide metal caps on flanges.
1. Structural Classification: Intermediate-duty system.
 2. End Condition of Cross Runners: Override (stepped) or butt-edge type, as standard with manufacturer.
 3. Face Design: Flat, flush.
 4. Cap Material: Steel cold-rolled sheet or aluminum.
 5. Cap Finish: Painted white.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
- B. Suspend ceiling hangers from building's structural members and as follows:
1. Hangers shall be single lengths of wire without splices; coordinate lengths in deep ceiling cavities.

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2. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 3. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 4. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 5. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 6. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 7. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 8. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 9. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 10. Do not attach hangers to steel deck tabs.
 11. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 12. Space hangers not more than **48 inches** o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than **8 inches** from ends of each member.
 13. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Suspension system shall be reinforced to support diffusers, light fixtures and any additional members. Install hanger wires to grid at each corner of light fixtures. Coordinate location with electrical and other trades.
1. Each individual fixture and attachment with combined weight of 56 pounds or less shall have two 12-gage wire hangers attached at diagonal corners of the fixture. These wires shall be slack. Fixtures and attachments with a combined weight of greater than 56 pounds shall be independently supported from the structure at all four corners.
- E. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

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1. Screw attach moldings to substrate at intervals not more than **16 inches** o.c. and not more than **3 inches** from ends, leveling with ceiling suspension system to a tolerance of **1/8 inch in 12 feet**. Miter corners accurately and connect securely.
 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- F. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- G. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 - b. Install panels with pattern running in one direction parallel to long axis of space.
 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
 3. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 5. Install hold-down clips in areas within 10 feet of exterior doors or vestibule doors; space as recommended by panel manufacturer's written instructions, unless otherwise indicated or required.

3.4 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Before Contractor installs acoustical panel ceilings, conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of acoustical panels until deficiencies have been corrected.
1. Complete the following in areas to receive gypsum board ceilings:
 - a. Installation of 80 percent of lighting fixtures, powered for operation.
 - b. Installation, insulation, and leak and pressure testing of water piping systems.
 - c. Installation of air-duct systems.
 - d. Installation of air devices.
 - e. Installation of mechanical system control-air tubing.
 - f. Installation of penetration firestopping.

3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Plaster.
 - 2. Existing previously painted plaster.
 - 3. Spray painting of mechanical registers, diffusers and grilles
- B. This Section includes exposed interior items and surfaces with low VOC coatings complying with ME DEP regulations.
- C. Related Sections include the following:
 - 1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
 - 2. Division 08 Sections for factory priming windows and doors with primers specified in this Section.

1.3 SUBMITTALS

- A. Product List: For each product indicated, include the following:
 - 1. Product data.
 - 2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
 - 3. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 4. Include printed statement of VOC content for each product.
- B. Samples for Initial Selection: For each type of topcoat product indicated.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.

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1. Submit Samples on rigid backing, **8 inches** square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced Applicator who has completed painting system applications similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations: Obtain block fillers, primers and undercoat materials for each coating system from the same manufacturer as the finish coats.
- C. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Architect will select one surface to represent surfaces and conditions for application of general wall paint system specified in Part 3.
 - a. Wall and Ceiling Surfaces: Provide samples of at least **100 sq. ft.**
 - b. Other Items: Architect will designate items or areas required.
 2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
 3. Final approval of color selections will be based on benchmark samples.
 - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than **45 deg F**.
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between **50 and 95 deg F**.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than **5 deg F** above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

1. Benjamin Moore & Co.
2. Sherwin Williams
3. ICI Paints

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content 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. Nonflat 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.
7. Flat Topcoat Paints: VOC content of not more than 50 g/L.
8. Nonflat Topcoat Paints: VOC content of not more than 150 g/L.
9. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
10. Floor Coatings: VOC not more than 100 g/L.
11. Shellacs, Clear: VOC not more than 730 g/L.
12. Shellacs, Pigmented: VOC not more than 550 g/L.
13. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
14. Dry-Fog Coatings: VOC content of not more than 400 g/L.
15. Zinc-Rich Industrial Maintenance Primers: VOC content of not more than 340 g/L.
16. Pre-Treatment Wash Primers: VOC content of not more than 420 g/L.

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- C. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
 2. Restricted Components: Paints and coatings shall not contain any of the following:
 - a. Acrolein.
 - b. Acrylonitrile.
 - c. Antimony.
 - d. Benzene.
 - e. Butyl benzyl phthalate.
 - f. Cadmium.
 - g. Di (2-ethylhexyl) phthalate.
 - h. Di-n-butyl phthalate.
 - i. Di-n-octyl phthalate.
 - j. 1,2-dichlorobenzene.
 - k. Diethyl phthalate.
 - l. Dimethyl phthalate.
 - m. Ethylbenzene.
 - n. Formaldehyde.
 - o. Hexavalent chromium.
 - p. Isophorone.
 - q. Lead.
 - r. Mercury.
 - s. Methyl ethyl ketone.
 - t. Methyl isobutyl ketone.
 - u. Methylene chloride.
 - v. Naphthalene.
 - w. Toluene (methylbenzene).
 - x. 1,1,1-trichloroethane.
 - y. Vinyl chloride.
- D. Colors: Provide color selections made by the Architect. Allow for up to ten (10) different color selections. Each color may be specified in varying sheens for varying substrates.
- 2.3 SOLVENT REQUIREMENTS: For applications that are inside of the weatherproofing system use:
- A. Paints, paint primers and coatings that comply with the following limits for VOC content limits of Green Seal Standard GS-11, Paints, First Edition, May 20, 1993.

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- B. Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates must not exceed the VOC limit of 250 g/L as established in Green Seal Standard GS-03, Anti-Corrosive Paints, Second Edition, January 7, 1997.
- C. Clear wood finishes, floor coatings, stains, and shellacs applied to interior elements must not exceed the South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, rules in effect January 1, 2004.

2.4 PRIMERS/SEALERS

- A. Low-VOC Latex Primer/Sealer:
 - 1. Moore: Pristine Eco Spec Interior Latex Primer Sealer, No. 231
- B. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.

2.5 METAL PRIMERS

- A. Rust-Inhibitive Primer (Water Based):
 - 1. Moore: IMC Acrylic Metal Primer M04. (51 g/L)

2.6 LATEX PAINTS

- A. Low-VOC Latex (Flat):
 - 1. Moore: Pristine Eco Spec Interior Latex Flat, No. 219.
- B. Low-VOC Latex (Low Luster):
 - 1. Moore: Pristine Eco Spec Interior Latex Eggshell, No. 223
- C. Low-VOC Latex (Semigloss):
 - 1. Moore: Pristine Acrylic Semi-Gloss, No. 214

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

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- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (Clay and CMU): 12 percent.
 - 3. Wood: 15 percent.
 - 4. Gypsum Board: 12 percent.
- 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.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. 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.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
 - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

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- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints. Uniformly abrade galvanized surfaces with a palm sander and 60 grit aluminum oxide so surface is free of oil and surface contaminants.
- H. Wood Substrates:
 - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 2. Sand surfaces that will be exposed to view, and dust off.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- I. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.
- J. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Apply an additional coat of primer on metal surfaces that have been shop primed.
- B. Tinting: Tint primer of colors such as reds, yellows, and oranges with a gray basecoat system designed to help provide color coverage.
 - 1. Do not tint prime or base coat for multi-colored finishes.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces. When using colors such as red, yellow or orange, an extra coat of finish may be necessary. Notify Architect when additional coats do not fix the problem.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

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- E. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
1. Mechanical, Plumbing and Fire Protection Work:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Tanks that do not have factory-applied final finishes.
 - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 2. Electrical Work:
 - a. Switchgear.
 - b. Panelboards.
 - c. Electrical equipment that is indicated to have a factory-primed finish for field painting.

3.4 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.

3.5 INTERIOR PAINTING SCHEDULE

- A. VOC Compliance, General: Provide the manufacturers' formulations for the products specified below that comply with the VOC requirements for the State of Maine Department of Environmental Protection in paragraph 2.2 of this Section.
- B. Steel Substrates: Including, but not limited to steel doors and frames, steel stairs (including risers and stringers), handrails and guardrails, lintel plates and angles, wood door glass lite kits

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and astragals, access panels (both sides), metal fabrications; see Division 05 Section "Metal Fabrications", and miscellaneous metal items.

1. Low-VOC Latex Over DTM Primer System:
 - a. Prime Coat: DTM anticorrosive metal primer.
 - b. Intermediate Coat: Low-VOC latex paint matching topcoat.
 - c. Topcoat: Low-VOC latex semi-gloss paint.

C. Galvanized-Metal Substrates:

1. Low-VOC Latex Over DTM Primer System:
 - a. Prime Coat: DTM anticorrosive metal primer.
 - b. Intermediate Coat: Low-VOC latex paint matching topcoat.
 - c. Topcoat: Low-VOC latex semi-gloss paint.

D. Gypsum Board and Plaster Substrates:

1. Low-VOC Latex System:
 - a. Prime Coat: Low-VOC latex primer/sealer.
 - b. Intermediate Coat: Low-VOC latex paint matching topcoat.
 - c. Topcoat: Low-VOC latex (flat for ceilings) (eggshell for walls) paint.
 - d. Previously Painted Existing Gypsum Board: Topcoat only

E. Cotton or Canvas Insulation-Covering Substrates: Including acoustic insulation panels.

1. Latex System:
 - a. Prime Coat: Latex primer/sealer.
 - b. Intermediate Coat: Latex paint matching topcoat.
 - c. Topcoat: Latex flat paint.

END OF SECTION 099123

SECTION 23 05 00 – COMMON WORK RESULTS FOR MECHANICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. This section applies to Division 21, 22, & 23 sections.

1.2 GENERAL

- A. This Section includes mechanical items common to all of this division specification sections.
- B. Provide services, skilled and common labor, and all apparatus and materials required for the complete installation as shown and within the intent of the contract documents, field conditions, and code requirements.
- C. The intention of these Contract Documents is to call for finished work, fully tested and ready for operation. Any components or labor not mentioned in the Contract Documents but required for functioning systems shall be provided. Should there appear to be any discrepancies or questions of intent, the Contractor shall refer the matter to the Architect/Engineer for decision before start of any related work.
- D. This contractor will be responsible to carry out the commissioning requirements specified. Refer to Division 1 for additional requirements.

1.3 MANUFACTURERS INSTRUCTIONS

- A. Provide equipment and components to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Follow manufacturer's instructions for inspection, start-up, calibration, and testing.

1.4 EFFICIENCY MAINE

- A. This project intends to pursue Efficient Maine prescriptive and/or custom incentives. The contractor shall participate in the activities associated with Efficiency Maine incentive approval process including but not limited to; preparation and submission of required incentive applications and the tracking and submission of measure specific invoices to Efficiency Maine within 60 days of the completion of the work.

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- B. The contractor shall also:
1. Become familiar with the Efficiency Maine Business Program including available incentives and the application and review process.
 2. <http://www.energymaine.com/at-work/business-programs/>
 3. Review plans and specifications for compliance with Efficiency Maine standards for applicable systems and technologies.
 4. Review plans and specifications for any and all incentive opportunities.
- C. The project schedule shall reflect and accommodate the time required to achieve application pre-approval from Efficiency Maine (EM). No equipment shall be purchased until pre-approval is received from EM.
- D. All invoices shall be forwarded to EM within 60 days of the completion of work. This deliverable shall be shown on the project schedule as a milestone date and coordinated with all contractors to assure compliance with this requirement.
- E. Efficiency Maine is available to assist in the application process and can be reached at 866-376-2463. Contractor must contact EM prior to submittals to review the project equipment and scope.
- F. As a minimum, obtain rebates for the following:
1. Water Cooled VRF System

1.5 DEFINITIONS

- A. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- B. "Provide": Furnish and install, complete and ready for the intended use.
- C. "Shall": The word shall is used to indicate mandatory requirements strictly to be followed in order to conform to the standard and procedures and from which no deviation is permitted.
- D. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and attics.
- E. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- F. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- G. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

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- H. 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.
- I. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

1.6 SUBMITTALS

- A. Provide in accordance with Division 1 of the specifications.

1.7 SUBSTITUTIONS

- A. Provide in accordance with Division 1 of the specifications.

1.8 QUALITY ASSURANCE

- A. All work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local, state, and federal authorities. Such codes, when more restrictive, shall take precedence over these plans and specifications.
- B. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
- C. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- D. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications." Comply with provisions in ASME B31 Series, "Code for Pressure Piping." Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- E. Electrical Characteristics for 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.
- F. The Contractor shall hold a license to perform the work as issued by the local jurisdiction.
- G. Plumbing work shall be performed by, or under, the direct supervision of a licensed master plumber.
- H. Electrical work shall be performed by, or under, the direct supervision of a licensed electrician.

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- I. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
 - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Engineer will determine which products shall be used.

1.9 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 1.
- B. Piping:
 - 1. Pipe and tube required by the applicable standard to be cleaned and capped shall be delivered to the job site with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
 - 2. Protect stored pipe and tube from moisture and dirt. Elevate above grade. When stored inside, do not exceed the structural capacity of the floor.
 - 3. Protect fittings, flanges, and piping specialties from moisture and dirt.
 - 4. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.10 COORDINATION

- A. Coordinate use of project space and sequence of installation of mechanical and electrical work, which is indicated diagrammatically on drawings. Follow routings shown for pipes, ducts, and conduits as closely as practicable, with due allowance for available physical space; make runs parallel with lines of building. Utilize space efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- B. The drawings show the general arrangement of systems and equipment but do not show all required fittings and offsets that may be necessary to connect pipes and ductwork to equipment, and to coordinate with other trades. Provide all necessary fittings, offsets and runs based on field measurements and at no additional cost. Coordinate with other trades for space available and relative location of equipment and accessories. Pipe and duct location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.
- C. Corrections or comments made on the Shop Drawings during the review do not relieve Contractor from compliance with requirements of the drawings and specifications. The Contractor is responsible for: confirming and correcting all quantities; checking electrical characteristics and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner.

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- D. Coordinate use of project space and sequence of installation of work.
- E. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for installations. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- F. Coordinate requirements for access panels and doors for items requiring access that are concealed behind finished surfaces. Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced.
 - 1. Access panels and doors are specified and provided by Division 8.

1.11 TEST ADJUST AND BALANCE READINESS

- A. The Contractor shall provide and coordinate the services of qualified, responsible sub-contractors, suppliers and personnel as required to correct, repair, and/or replace any and all deficient items or conditions found during the course of this project, including the testing, adjusting, and balancing period.
- B. In order that all systems may be properly tested, balanced, and adjusted as required herein by these Specifications, the Contractor shall operate the systems at his expense for the length of time necessary to properly verify their completion and readiness for TAB.
- C. Project Contract completion schedules shall allow for sufficient time to permit the completion of TAB services prior to Owner occupancy. The Contractor shall allow adequate time for the testing and balancing activities of the Owner provided services, during the construction period, and prior to Substantial Completion as defined in the Uniform General Conditions of this Construction Document.
- D. The Drawings and Specifications indicate valves, dampers, and miscellaneous adjustment devices for the purpose of adjustment to obtain optimum operating conditions, and it will be the responsibility of the Contractor to install these devices in a manner that will leave them accessible and readily adjustable. Should any such device not be readily accessible, the Contractor shall provide access as requested by the TAB Firm. Also, any malfunction encountered by TAB personnel and reported to the Contractor shall be corrected by the Contractor immediately so that the balancing work can proceed with the minimum of delays.
- E. Complete operational readiness of the HVAC systems also requires that the following be accomplished:
 - 1. Distribution Systems:
 - a. Verify installation for conformity to design. All supply, return, and exhaust ducts shall be terminated and tested as required by the Specification.
 - b. Dampers shall be properly located and functional. Dampers shall have tight closure and open fully with smooth and free operation.

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- c. Supply, return, exhaust, and transfer grilles, registers, diffusers, and terminal devices shall be installed and secured in a full open position.
 - d. Air handling systems, units, and associated apparatus shall be sealed to eliminate uncontrolled bypass or leakage of air. Final clean filters shall be in place, coils shall be clean with fins straightened, bearings properly greased, and the system shall be completely operational. The Contractor shall verify that all systems are operating within the design pressure limits of the piping and ductwork.
 - e. Under normal operating conditions, check condensate drains for proper connections and functioning. Cooling coil drain pans have a positive slope to drain. Cooling coil condensate drain trap maintains an air seal.
 - f. Check for proper sealing of air-handling unit components.
 - g. Fans shall be operating and verified for freedom from vibration, proper fan rotation and belt tension; heater elements in motor starters to be of proper size and rating, as per the starter manufacturer; record motor amperage and voltage on each phase at start-up, and verify they do not exceed nameplate ratings.
 - h. Thermal overload protection is in place for fans and other equipment. Bearings shall be greased. Belts shall be aligned and tight
 - i. Terminal units shall be installed and functional (i.e. controls functioning).
2. Water Circulating Systems:
- a. Verify installation for conformity to design. Hydronic systems are pressure tested, flushed, filled, and properly vented. Service and balance valves are fully open. Examine HVAC system and equipment installations to verify that indicated balancing devices are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation
 - b. All valves shall be set to their full open position. After the system is flushed and checked for proper operation, all strainers shall be removed and cleaned. The Contractor shall repeat the operation until circulating water is clean and then the start-up strainers shall be discarded. Bearings shall be greased.
 - c. Record pump motor amperage on each phase and voltage after reaching rated speed. Readings shall not exceed nameplate rating. Verify that the electrical heater elements are of the proper size and rating as per the starter manufacturer.
 - d. In preparation of TAB, water circulating systems shall be full and free of air, expansion tanks shall be set for proper water level, and all air vents shall be installed at high points of systems and operating freely. Chemicals shall be added to closed systems to treat piping and inhibit corrosion. The system static pressure shall be adequate to completely fill the system without operating the pumps.
 - e. Check and set operating parameters of the heat transfer and control devices to the design requirements.
 - f. Proper balancing devices shall be in place and located correctly. These devices include but are not limited to flow meters, pressure taps, thermometer wells, balancing valves, etc. Heat transfer coils shall be checked for correct piping connections.

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3. Automatic Controls
 - a. The BAS Contractor shall verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, damper sequences, air and water resets, fire and freeze stats, high and low temperature thermostats, safeties, etc.
 - b. The BAS Contractor shall verify that all controlling instruments are calibrated and set for design operating conditions with the exception of components that require input from the TAB Agency, but a default shall be set. The Control Contractor shall cooperate with the TAB Agency and provide all software and interfaces to communicate with the system.
 - c. The BAS Contractor shall thoroughly check all controls, sensors, operators, sequences, etc. before notifying the TAB Agency that the BAS is operational. The BAS Contractor shall provide technical support (technicians and necessary computers) to the TAB Agency for a complete check of these systems.
 - d. Prior to occupancy, each ventilation system shall be tested to ensure that OA dampers operate properly in accordance with system design.

1.12 RENOVATION PROJECTS

- A. Project Conditions: Full Owner Occupancy: The Owner intends to occupy the project site during construction. The Contractor shall cooperate with the Owner to minimize conflicts with the Owner's operations.
- B. The Contractor shall study all drawings and specifications, visit the site, and get acquainted with the existing conditions and the requirements of the plans and specifications. No claim will be recognized for extra compensation due to the failure of the Contractor to be familiarized with the conditions and extent of the proposed work. The Contractor shall execute all alterations, additions, removals, relocations or new work, etc., as indicated or required to provide a complete installation in accordance with the intent of the drawing and specifications.
- C. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of site beyond areas in which the Work is indicated.
- D. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize use of driveways and entrances. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- E. Follow the recommended procedures of the SMACNA IAQ Guidelines for Occupied Buildings under Construction.
 1. Dust partitions and depressurization of the work are performed under Division 1.
 2. The return side of an HVAC system is, by definition, under negative pressure and thus capable of drawing in nearby construction dust and odor. When possible, the entire system shall be shut down during heavy construction or demolition. The system shall be

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- isolated from the surrounding environment as much as possible (e.g., all tiles in place for a ceiling plenum, duct and air handler leaks repaired) to prevent induction of pollutants.
3. Return system openings in (and immediately adjacent to) the construction area shall be sealed with plastic.
 4. When the system must remain operational during construction, temporary filters shall be added to return grilles. All filters must receive frequent periodic maintenance and be replaced at end of project.
 5. When the general system must remain operational, the heaviest work areas shall be dampered off or otherwise blocked if temporary imbalance of the return air system does not create a greater problem.
 6. The mechanical room shall not be used to store construction or waste materials.
 7. Diffusers, VAV boxes, and ducts may be adequately protected in most cases where the above measures are implemented. When the system is off for the duration of construction, diffusers shall also be sealed in plastic for further protection. Ducts, diffusers, and window units shall be inspected upon completion of the work for the amount of deposited particulate present and cleaned where needed. If significant dust deposits are observed in the system during construction, some particulate discharge can be expected during start-up. When such a discharge is only minor, delaying re-occupancy long enough to clean up the dust may be sufficient. In more severe cases, installing temporary coarse filters on diffusers or cleaning the ducts may be necessary. The condition of the main filters shall be checked whenever visible particulates are discharged from the system.
- F. Continuity of Services: The building will be in use during construction operations. Maintain existing systems in operation within all rooms of building at all times. Refer to “General Conditions of the Contract for Construction” for temporary facilities for additional contract requirements. Schedules for various phases of contract work shall be coordinated with all other trades and with Owner’s Representative. Provide, as part of contract, temporary plumbing and mechanical and electrical connections and relocations as required to accomplish the above.
- G. Existing Utilities: 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. Notify Owner at least two days in advance of proposed utility interruptions. Identify extent and duration of utility interruptions. Indicate method of providing temporary utilities. Do not proceed with utility interruptions without Owner's written permission.
- H. Cutting And Patching
1. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed. Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.
 2. Temporary Support: Provide temporary support of Work to be cut.
 3. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

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4. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
5. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
6. Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
7. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - a. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - b. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - c. Concrete or Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
8. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
 - a. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 - b. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing. Clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.
9. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
10. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
11. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

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PART 2 - PRODUCT

2.1 PRODUCT CRITERIA

- A. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. See other specification sections for any exceptions.
- B. Equipment Service: Products shall be supported by a service organization that maintains a complete inventory of repair parts and is located reasonably close to the site.
- C. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
- D. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
- E. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
- F. Asbestos products or equipment or materials containing asbestos shall not be used.

2.2 PIPE JOINING MATERIALS

- A. Refer to individual Division 22 and 23 piping Sections for pipe, tube, and fitting materials and joining methods. Refer to individual piping Sections for special joining materials not listed below.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.
- C. 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. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges. 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.
- D. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- E. Mechanical Coupling Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents and exterior environment. Gasket design shall be such that the entire

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coupling housing is isolated from the system contents to prevent galvanic action and inhibit galvanic corrosion.

- F. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- G. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- H. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAgl, silver alloy for refrigerant piping, unless otherwise indicated.
- I. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- J. Solvent Cements for Joining Plastic Piping: CPVC Piping: ASTM F 493. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- K. Press connections: Copper and copper alloy press connections shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tools approved by the manufacturer.

2.3 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. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- C. Flexible Transition Couplings for Underground Non-pressure Drainage Piping: ASTM C 1173 with elastomeric sleeve; ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.4 DIELECTRIC FITTINGS

- A. Provide where copper tubing and ferrous metal pipe are joined.
- B. Fittings shall match piping specifications. Threaded dielectric union, ANSI B16.39. Watts Series LF3000 (lead free) or approved equal. Flange union with dielectric gasket and bolt sleeves, ANSI B16.42. Dielectric flange fittings: Watts Series LF3100.

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2.5 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Mechanical Sleeve Seals: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve; Thunderline Link-Seal, or approved equal.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Glass-reinforced nylon.
 - 3. Connecting Bolts and Nuts: Stainless steel, of length required to secure pressure plates to sealing elements.

2.6 ESCUTCHEONS

- A. Escutcheons shall be manufactured from nonferrous metals and shall be chrome-plated. Metals and finish shall conform to ASME A112.19.2. Escutcheons shall be one-piece type where mounted on chrome-plated pipe or tubing, and one-piece of split-pattern type elsewhere. ID shall closely fit around pipe, tube, and insulation of insulated piping and an OD that completely cover the opening.
- B. All escutcheons shall have setscrews for maintaining a fixed position against a surface.

2.7 ROOFING

- A. Coordinate roofing with Division 7.
- B. Roof Edge Protection System, required for any mechanical items located within 10 feet of roof edge.
 - 1. Roof edge protection system shall be KeeGuard Roof Edge Protection System, or approved equal. System shall be a counterweighted guardrail system with 42" min. height to provide code-compliant protection for mechanical equipment located less than

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10 feet from the edge of the roof. System shall withstand a minimum load of 200 lbs. in any direction to all components per OSHA Regulation 29 CFR 1910.23.

2. Components: Pipe: ASTM A53 1-1/2 inch schedule 40, Galvanized. Rails, Posts, and fittings: 1-1/2 inch diameter steel pipe, galvanized. Mounting Bases: Galvanized steel bases to have a rubber pad placed under the plate at the job site. Counterweights: Galvanized steel counterweights to have a rubber pad placed under the plate at the job site. Finish: galvanized mill finish to the requirements of ASTM A53. Provide per manufacturers recommendations.

2.8 VIBRATION ISOLATION

- A. All equipment shall be isolated to prevent vibration transmission to the building structure.

PART 3 - EXECUTION

3.1 DEMOLITION AND REMOVALS

- A. Refer to Division 1 for general demolition requirements and procedures.

3.2 COMMON REQUIREMENTS

- A. Provide piping, ductwork, and equipment to allow maximum possible headroom unless specific mounting heights are indicated. Provide equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- B. Provide 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.
- C. Coordinate location of piping, sleeves, inserts, hangers, ductwork and equipment. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, light outlets, and other services and utilities.
- D. Any structural member weakened or impaired by cutting, notching, or otherwise shall be reinforced, repaired, or replaced so as to be left in safe structural condition in accordance with the local building code requirements.
- E. Provide piping and ductwork in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- F. Provide 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.

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- G. Provide systems above accessible ceilings to allow sufficient space for ceiling panel removal.
- H. Provide piping to permit valve servicing.
- I. Provide equipment and other components to allow right of way for piping installed at required slope.
- J. Provide free of sags and bends.
- K. Provide unions or flanges at connections to equipment.
- L. Provide fittings for changes in direction and branch connections.
- M. Make allowances for application of insulation.
- N. Select system components with pressure rating equal to or greater than system operating pressure.
- O. Verify final equipment locations for roughing-in.
- P. Protection and Cleaning: Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations. Damaged or defective items shall be replaced. Protect all finished parts of equipment. Close duct and pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water, chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and the relevant specification section specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Joints shall be fabricated, joined, and tested per the piping and fitting manufacturer's instructions. Joint preparation, setting and alignment, joining process, timing, hanger spacing, and working pressure shall be in accordance with the pipe and fitting manufacturer's specifications.
- D. Installer Qualifications
 - 1. Pipe fitters shall be qualified to the procedure used to perform the pipe joining.
 - 2. The contractor is responsible for documenting all qualification and training records of each pipe fitter. Pipe fitters shall have current, formal training on the pipe joining method.

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3. Contractor must submit documentation that lists personnel assigned to this project prior to beginning construction who have successfully completed formal training conducted by an authorized manufacturer's representative. The Contractor Training documentation shall be specific to the manufacturer of the pipe and fittings.
 4. Personnel's training documentation must be current and have been updated within the past two (2) years. Training received more than two years prior to operation with no evidence of activity within the past 6 months shall not be considered current.
 5. Piping Warranty: Contractor shall provide and document required training and required by the piping system manufacturer in order to maintain the piping manufacturer's warranty.
- E. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedures recommended by fitting manufacturer. Leave insertion marks on pipe after assembly.
- F. 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.
- G. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.
- H. 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.
- I. Fusion Joints: The employer of the fusion machine operator is responsible for the fusion joint quality of the fusion weld made by that individual. Fusion equipment operators shall be qualified to the procedure used to perform pipe joining. Fusion equipment operators shall have current, formal training on all fusion equipment employed on the project. Training received more than two years prior to operation with no evidence of activity within the past 6 months shall not be considered current.
- J. Pipe Joint Construction: PEX-a Connections: Provide per manufacturer's recommendations. Use manufacturer-recommended cold-expansion tool for F1960 connections.
- K. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- L. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Provide gasket concentrically positioned. Use suitable lubricants on bolt threads.

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- M. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 3. PVC Piping: Join according to ASTM D 2855.

3.4 PIPE PENETRATIONS & SLEEVES

- A. Provide sealants for all pipe penetrations. All pipe penetrations shall be sealed.
- B. Refer to Section 23 07 00 "Mechanical Insulation".
- C. Provide allowance for thermal expansion and contraction of copper tubing passing through a wall, floor, ceiling or partition by wrapping with an approved tape or pipe insulation or by installing through an appropriately sized sleeve.
- D. Sleeve Clearance: Sleeve through floors, walls, partitions, and beams shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation.
- E. Provide sleeves for pipes passing through concrete and masonry construction. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint. Cut sleeves to length for mounting flush with both surfaces. Provide sleeves in new walls and slabs as new walls and slabs are constructed. Provide steel pipe sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Piping through concrete or masonry shall not be subject to any load from the building construction.
1. Sleeves are not required in drywall construction.
 2. Sleeves are not required for core-drilled holes.
- F. To prevent accidental liquid spills from passing to a lower level, provide the following:
1. For sleeves: Extend sleeve 1-1/2 inch above finished floor and provide sealant for watertight joint.
 2. For blocked out floor openings: Provide 1-1/2 inch angle set in silicone adhesive around opening.
 3. For drilled penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
- G. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 7.

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H. Exterior- Pipe Penetrations:

1. Provide sleeve-seal systems in sleeves at service piping entries into building.
2. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

I. Escutcheons: Provide for penetrations in finished spaces where pipes are exposed. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

J. Plastic and copper piping penetrating framing members, and within one-inch of the framing, shall be protected with 10-gauge steel nailing plates. The steel plate shall extend along the framing member a minimum of 1.5" beyond the OD of the pipe or tubing.

3.5 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated: Provide unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment. Provide flanges in piping NPS 2-1/2 and larger, adjacent to valves and at final connection to each piece of equipment.

B. Provide dielectric fittings at connection between copper and ferrous metal.

C. Swing Connections for Expansion: Connect risers and branch connections to mains with at least five pipe fittings, including tee in main. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.6 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor 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. Provide fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

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3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Provide in accordance with Division 5.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor materials and equipment. Field Welding: Comply with AWS D1.1.

3.8 FIRESTOPPING

- A. Provide through-penetration firestop systems. Refer to Division 7 for materials. Seal penetrations through fire- or smoke-rated wall, partition, ceiling, or roof assemblies with firestopping systems. Refer to Architectural plans for location of rated assemblies.

3.9 PAINTING

- A. Painting of plumbing and mechanical systems, equipment, and components is specified in Division 9.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.10 ROOFING

- A. Refer to Division 7.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

3.11 PROJECT CLOSEOUT

- A. Provide Demonstration and Training in accordance Division 1.
- B. Provide Project Record Documents in accordance with Division 1.
- C. Follow Closeout procedures as per Division 1.
- D. Provide Operation and Maintenance information in accordance with Division 1. In addition, provide the following.
 - 1. An O&M manual describing basic data relating to the operation and maintenance of systems and equipment as installed.
 - 2. HVAC control information consisting of diagrams, schedules, control sequence narratives, and maintenance and/or calibration information.

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3. TAB report
4. Construction drawings of record, control drawings and final design drawings.

END OF SECTION 23 05 00

SECTION 23 05 19 – THERMOMETERS AND PRESSURE GAUGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 23 Section “Common Work Results for Mechanical”
 - 2. Mechanical equipment Sections that specify meters and gauges as part of factory-fabricated equipment.

1.2 SUMMARY

- A. This Section includes thermometers and pressure gauges.

1.3 ACTION SUBMITTALS

- A. Product Data: Include scale range, ratings, and calibrated performance curves for each gauge, fitting, specialty, and accessory specified.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ashcroft
 - 2. Weksler
 - 3. Ernst Gauge Co.
 - 4. Trerice: H. O. Trerice Co.
 - 5. Weiss Instruments, Inc.

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2.2 THERMOMETERS

- A. Liquid-In-Glass Industrial Thermometers: shall be a blue reading (Fill Type Spirit: Blue colored, organic) liquid-in-glass adjustable angle type, 9" scale, cast aluminum case with cured polyester powder coating, clear acrylic window and brass separable thermowell. Thermometers will be Trerice BX9 Series or approved equal.
- B. Scale Range: Temperature ranges for services listed are as follows: The proper range will be selected so that the operating temperature of the material being measured will fall approximately in the middle of the scale.
 - 1. Condenser Water: 30 to 130°F, with 11°F scale divisions.
- C. Thermowells: Provide fitting with protective socket for installation in threaded pipe fitting to hold fixed thermometer stem.
 - 1. Material: Brass, for use in copper piping.
 - 2. Material: Stainless steel, for use in steel piping.
 - 3. Where insulation thickness exceeds 2", a longer stem thermometer will be used with an extension neck brass separable thermowell. The extension neck will be at least 2" long.
 - 4. Thermometers for measuring fluid temperatures will have stems with insertion lengths of roughly half of the pipe diameter; minimum insertion length will be 2".
 - 5. Cap: Threaded, with chain permanently fastened to socket. Heat-Transfer Fluid: Mixture of graphite and glycerin.

2.3 PRESSURE GAUGES

- A. Pressure gauges shall be 3½" dial size with a flangeless cast aluminum case, stainless steel friction ring and glass window. Movement will be brass with a bronze bourdon tube and brass socket. Dial face will be white with black figures; pointer will be friction adjustable type. Accuracy shall be ±1% of scale range, ASME B40.1 Grade 1A. Pressure gauges will be Trerice No. 600CB approved equal.
 - 1. Connector: Brass, NPT 1/4.
 - 2. Units of Measure: PSI
 - 3. Provide silicone-damped movement.
 - 4. Range: The proper range shall be selected so that the average operating pressure falls approximately in the middle of the scale selected.
 - 5. Provide pressure-gauge needle valve and snubber (Trerice No. 872 pressure snubbers) in piping to pressure gauges; ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.
 - 6. Needle Valves: Trerice 735 Series; NPS 1/4 brass or 316 stainless steel needle type.
- B. Scale Range: Pressure ranges for services listed are as follows: The proper range will be selected so that the operating pressure of the material being measured will fall approximately in the middle of the scale.
 - 1. Condenser Water: 0 to 60 psi.

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2.4 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flow Design, Inc.
 - 2. Peterson Equipment Co., Inc.
 - 3. Trerice, H. O. Co.
 - 4. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - 5. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide according to manufacturer's written instructions for applications where used.
- B. Provide thermometers and adjust vertical and tilted positions. Provide thermowells with extension on insulated piping. Provide separable sockets in vertical position in piping tees.
- C. Provide pressure gauges in piping tees with pressure-gauge valve located on pipe at most readable position. Provide valve and snubber in piping for each pressure gage for fluids.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 and 23 Sections. Drawings indicate general arrangement of piping and specialties. Provide adjacent to machines and equipment to allow service and maintenance. Connect per manufacturers recommendations.

3.3 ADJUSTING AND CLEANING

- A. Calibrate according to manufacturer's written instructions, after installation.
- B. Adjust faces to proper angle for best visibility.

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- C. Clean windows and clean factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touchup paint.

END OF SECTION 23 05 19

SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 23 Section "Common Work Results for Mechanical"
 - 2. Division 23 Section "Mechanical Insulation"

1.2 SUMMARY

- A. This Section includes hangers and supports for piping and equipment.

1.3 ACTION SUBMITTALS

- A. Submit product data on all hanger and support devices, including shields and attachment methods. Product data to include, but not limited to materials, finishes, approvals, load ratings, and dimensional information.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Pipe stands.
 - 4. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 QUALITY ASSURANCE

- A. Provide in accordance with MSS SP69 - Manufacturers Standardization Society: Pipe Hangers and Supports- Selection and Application

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- B. Steel pipe hangers and supports shall have the manufacturer's name, part number, and applicable size stamped in the part itself for identification.
- C. Pipe Hangers, Supports, and Components: The materials of all pipe hanging and supporting elements shall be in accordance with MSS SP-58.
- D. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. B-Line Systems, Inc.
 - 2. Carpenter & Patterson, Inc.
 - 3. Grinnell Corp.
 - 4. Hubbard Enterprises/Holdrite
 - 5. National Pipe Hanger Corp.
 - 6. Piping Technology & Products, Inc.
 - 7. Unistrut
 - 8. Anvil International, Inc.
 - 9. Empire

2.2 PIPE HANGERS AND SUPPORTS

- A. Conform to Manufacturers Standardization Society ANSI/MSS SP-69 & SP-58 – Types indicated below.
- B. Hangers:
 - 1. Uninsulated pipes 2 inch and smaller:
 - a. Adjustable steel swivel ring (band type) hanger, Type 10, B-Line B3170.
 - b. Adjustable steel swivel J-hanger, Type 5, B-Line B3690.
 - c. Malleable iron ring hanger, Type 12, B-Line B3198R or hinged ring hanger, B3198H.
 - d. Adjustable steel clevis hanger, Type 1, B-Line B3100.
 - 2. Uninsulated pipes 2-1/2 inch and larger:
 - a. Adjustable steel clevis hanger, Type 1, B-Line B3100.
 - b. Pipe roll with sockets, Type 41, B-Line B3114.
 - c. Adjustable steel yoke pipe roll, Type 43, B-Line B3110.

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3. Insulated pipe- Hot piping:
 - a. 2 inch and smaller pipes: use adjustable steel clevis with galvanized sheet metal shield. Type 1, B-Line B3100 with Type 40, B-Line B3151 series insulation protection shield.
 - b. 2-1/2 inch and larger pipes: Type 41 or Type 43 with Type 39A/39B, B3160-B3165 series pipe covering protection saddle.
 4. Insulated pipe- Cold piping:
 - a. 5 inch and smaller pipes: use adjustable steel clevis with galvanized sheet metal shield. Type 1, B-Line B3100 with Type 40, B-Line B3151 series insulation protection shield.
 - b. 6 inch and larger pipes: Type 41 or Type 43 with Type 39A/39B, B3160-B3165 series pipe covering protection saddle.
- C. Pipe Clamps: When flexibility in the hanger assembly is required due to horizontal movement, use pipe clamps with weldless eye nuts, Type 4, B-Line B3140. For insulated lines use double bolted pipe clamps, Type 3, B-Line B3144.
- D. Multiple or Trapeze Hanger
1. Trapeze hangers shall be constructed from 12 gauge roll formed ASTM A1011 SS Grade 33 structural steel channel, 1-5/8 inch by 1-5/8 inch minimum, B-Line B22 strut or stronger as required.
 2. Mount pipes to trapeze with 2 piece pipe straps sized for outside diameter of pipe, B-Line B2000 Series.
 3. For pipes subjected to axial movement: Strut mounted roller support, B-Line B3126. Use pipe protection shield or saddles on insulated lines. Strut mounted pipe guide, B-Line B2417.
- E. Wall Supports
1. Pipes 4 inch and smaller: Carbon steel J-hanger, B-Line B3690.
 2. Pipes larger than 4 inch: Welded strut bracket and pipe straps, Type 31 light welded steel bracket, B-Line B3064. Provide Type 32 or Type 33 for heavier loads.
- F. Floor Supports
1. Hot piping under 6 inch and all cold piping: Carbon steel adjustable pipe saddle and nipple attached to steel base stand sized for pipe elevation. Type 38 adjustable pipe saddle, B-Line B3093 and B3088T base stand; or Type 39, B3090 and B3088 base stand. Pipe saddle shall be screwed or welded to appropriate base stand.
 2. Hot piping 6 inch and larger: Adjustable Roller stand with base plate, Type 46, B3118SL. Adjustable roller support and steel support sized for elevation, B-Line B3124.
- G. Vertical Supports: Steel riser clamp sized to fit OD of pipe, Type 8, B-Line B3373.

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H. Copper Tubing Supports

1. Hangers shall be sized to fit copper tubing outside diameters.
 - a. Adjustable steel swivel ring (band type) hanger, Type 10, B-Line B3170CT.
 - b. Malleable iron ring hanger, Type 12, B-Line B3198RCT or hinged ring hanger B3198HCT.
 - c. Adjustable steel clevis hanger, Type 1, B-Line B3104CT.
 2. For supporting copper tube to strut use epoxy painted pipe straps sized for copper tubing, B-Line B2000 series, or plastic inserted vibration isolation clamps, B-Line BVT series.
- I. Plastic Pipe Supports: V-Bottom clevis hanger with galvanized 18-gauge continuous support channel, Type 1, B-Line B3106 and B3106V plastic pipe support channel, to form a continuous support system for plastic pipe or flexible tubing.
- J. Supplementary Structural Supports: Design and fabricate supports using structural quality steel bolted framing materials as manufactured by Cooper B-Line. Channels shall be roll formed, 12 gauge ASTM A1011 SS Grade 33 steel, 1-5/8 inch by 1-5/8 inch or greater as required by loading conditions. Submit designs for pipe tunnels, pipe galleries, etc., to engineer for approval. Use clamps and fittings designed for use with the strut system.

2.3 UPPER ATTACHMENTS

A. Beam Clamps

1. Beam clamps shall be used where piping is to be suspended from building steel. Clamp type shall be selected on the basis of load to be supported, and load configuration.
2. C-Clamps shall have locknuts and cup point set screws, Type 23, B-Line B351L. Refer to manufacturer's recommendation for setscrew torque. Retaining straps shall be used to maintain the clamps position on the beam where required.

B. Concrete Inserts

1. Cast in place spot concrete inserts shall be used where applicable; either steel or malleable iron body, Type 18, B-Line B2500 or B3014. Spot inserts shall allow for lateral adjustment and have means for attachment to forms. Select inserts to suit threaded hanger rod sizes, B-Line N2500 or B3014N series.
2. Continuous concrete inserts shall be used where applicable. Channels shall be 12 gauge, ASTM A1011 SS Grade 33 structural quality carbon steel, complete with Styrofoam inserts and end caps with nail holes for attachment to forms. The continuous concrete insert shall have a load rating of 2,000 lbs/ft. in concrete, B-Line B22I, 32I, or 52I. Select channel nuts suitable for strut and rod sizes.

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2.4 VIBRATION ISOLATION AND SUPPORTS

- A. For air conditioning and other vibrating system applications, use a clamp that has a vibration dampening insert and a nylon inserted locknut. For copper and steel tubing use B-Line BVT-Series Vibraclamps.
- B. For larger tubing or piping subjected to vibration, use neoprene or spring hangers as required.
- C. For base mounted equipment use vibration pads, molded neoprene mounts, or spring mounts as required.

2.5 ACCESSORIES

- A. Hanger Rods shall be threaded both ends, or continuous threaded rods of circular cross section. Use adjusting locknuts at upper attachments and hangers. No wire, chain, or perforated straps are allowed.
- B. Shields shall be 180 degree galvanized sheet metal, 12 inch minimum length, 18 gauge minimum thickness, designed to match outside diameter of the insulated pipe, B-Line B3151.
- C. Pipe protection saddles shall be formed from carbon steel, 1/8 inch minimum thickness, sized for insulation thickness. Saddles for pipe sizes greater than 12 inch shall have a center support rib.

2.6 FINISHES

- A. Indoor Finishes:
 - 1. Hangers and clamps for support of bare copper piping shall be coated with copper colored epoxy paint, B-Line Dura-Copper®. Additional PVC coating of the epoxy painted hanger shall be used where necessary.
 - 2. Hangers for other than bare copper pipe shall be zinc plated in accordance with ASTM B633; or shall have an electro-deposited green epoxy finish, B-Line Dura-Green®.
 - 3. Strut channels shall be pre-galvanized in accordance with ASTM A653 SS Grade 33 G90 OR have an electro-deposited green epoxy finish, B-Line Dura-Green®.
- B. Outdoor Finishes: Hangers and strut located outdoors shall be hot dip galvanized after fabrication in accordance with ASTM A123. All hanger hardware shall be hot dip galvanized or stainless steel. Zinc plated hardware is not acceptable for outdoor or corrosive use.

2.7 METAL FRAMING SYSTEMS (“UNISTRUT”)

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-Line, Inc.
 - b. Flex-Strut Inc.
 - c. Thomas & Betts Corporation.
 - d. Unistrut Corporation; Tyco International, Ltd.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with in-turned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Coating: Unistrut Perma-green or similar.

2.8 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece plastic or stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Pipe Stand:
 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 2. Bases: One or more; plastic.
 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
 5. Pipe Supports, multiple pipes: Galvanized-steel, clevis-type pipe hangers.
- E. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Provide hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Provide per manufactures recommendations and calculations.
- D. Thermal-Hanger Shield Installation: Provide in pipe hanger or shield for insulated piping.
- E. Fastener System Installation: Provide powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Provide fasteners according to powder-actuated tool manufacturer's operating manual. Provide mechanical-expansion anchors in concrete after concrete is placed and completely cured. Provide fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation: Provide per manufactures recommendations and calculations. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.
- G. Provide hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- I. Provide 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.
- J. Provide lateral bracing with pipe hangers and supports to prevent swaying.
- K. Provide building attachments within concrete slabs or attach to structural steel. Provide additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Provide concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

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- L. Load Distribution: Provide hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Provide hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by plumbing code and ASME B31.9 for building services piping. Piping shall be supported in such a manner as to maintain its alignment and prevent sagging.
- N. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Thermal-Hanger Shields: Provide with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals. Obtain fusion without undercut or overlap. Remove welding flux immediately. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

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3.4 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.

3.5 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. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- E. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- F. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.7 HANGER SPACING

- A. Support piping and tubing not listed below according to MSS SP-69 and manufacturer's written instructions.

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- B. Provide hangers for steel piping with the following maximum horizontal spacing and minimum rod sizes:
1. NPS 1/2": Maximum span, 6 feet; minimum rod size, 3/8 inch.
 2. NPS 3/4 to 1: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 3. NPS 1-1/4: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 4. NPS 1-1/2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 5. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 6. NPS 2-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
 7. NPS 3: Maximum span, 10 feet; minimum rod size, 1/2 inch.
 8. NPS 4: Maximum span, 10 feet; minimum rod size, 5/8 inch.
 9. NPS 5: Maximum span, 10 feet; minimum rod size, 5/8 inch.
 10. NPS 6: Maximum span, 10 feet; minimum rod size, 3/4 inch.
 11. NPS 8: Maximum span, 10 feet; minimum rod size, 3/4 inch.
 12. NPS 10: Maximum span, 10 feet; minimum rod size, 7/8 inch.
 13. NPS 12: Maximum span, 10 feet; minimum rod size, 7/8 inch.
- C. Provide hangers for drawn-temper copper piping with the following maximum horizontal spacing and minimum rod sizes:
1. NPS 1/2 and 3/4: Maximum span, 5 feet; minimum rod size, 3/8 inch.
 2. NPS 1 to 1-1/2": Maximum span, 6 feet; minimum rod size, 3/8 inch.
 3. NPS 2: Maximum span, 9 feet; minimum rod size, 1/2 inch.
 4. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 1/2 inch.
 5. NPS 3: Maximum span, 10 feet; minimum rod size, 1/2 inch.
 6. NPS 4: Maximum span, 10 feet; minimum rod size, 1/2 inch.
 7. Maximum vertical steel and copper pipe attachment spacing: 10 feet.
- D. Piping Hangers for Plastic Piping:
1. Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
 2. In systems where large fluctuations in temperature occur, allowances must be made for expansion and contraction of the piping system. Since changes in direction in the system are usually sufficient to allow for expansion and contraction, hangers must be placed so as not to restrict this movement.
 3. Hangers shall not compress, distort, cut or abrade the piping. All piping shall be supported at intervals sufficiently close to maintain correct pipe alignment and to prevent sagging or grade reversal. Pipe should also be supported at all branch ends and at all changes of direction.
 4. Hangers shall be placed next to the pipe joint not more than 18" from the point joint.
 5. Maximum horizontal spacing and minimum rod diameters (pipe temperature 100°F or lower).
 - a. Solvent cemented PVC
 - 1) NPS 1 and smaller: 48" with 3/8-inch rod.
 - 2) NPS 1-1/4 to NPS 3: 48" with 3/8-inch rod.

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- 3) NPS 3: 48" with 1/2-inch rod.
- 4) NPS 4: 48" with 5/8-inch rod.
- 5) NPS 6 and 8: 48" with 3/4-inch rod.

- b. Solvent cemented CPVC
 - 1) NPS 1 and smaller: 36" with 3/8-inch rod.
 - 2) NPS 1-1/4 to NPS 3: 48" with 3/8-inch rod.
 - 3) NPS 3: 48" with 1/2-inch rod.
 - 4) NPS 4: 48" with 5/8-inch rod.
 - 5) NPS 6 and 8: 48" with 3/4-inch rod.

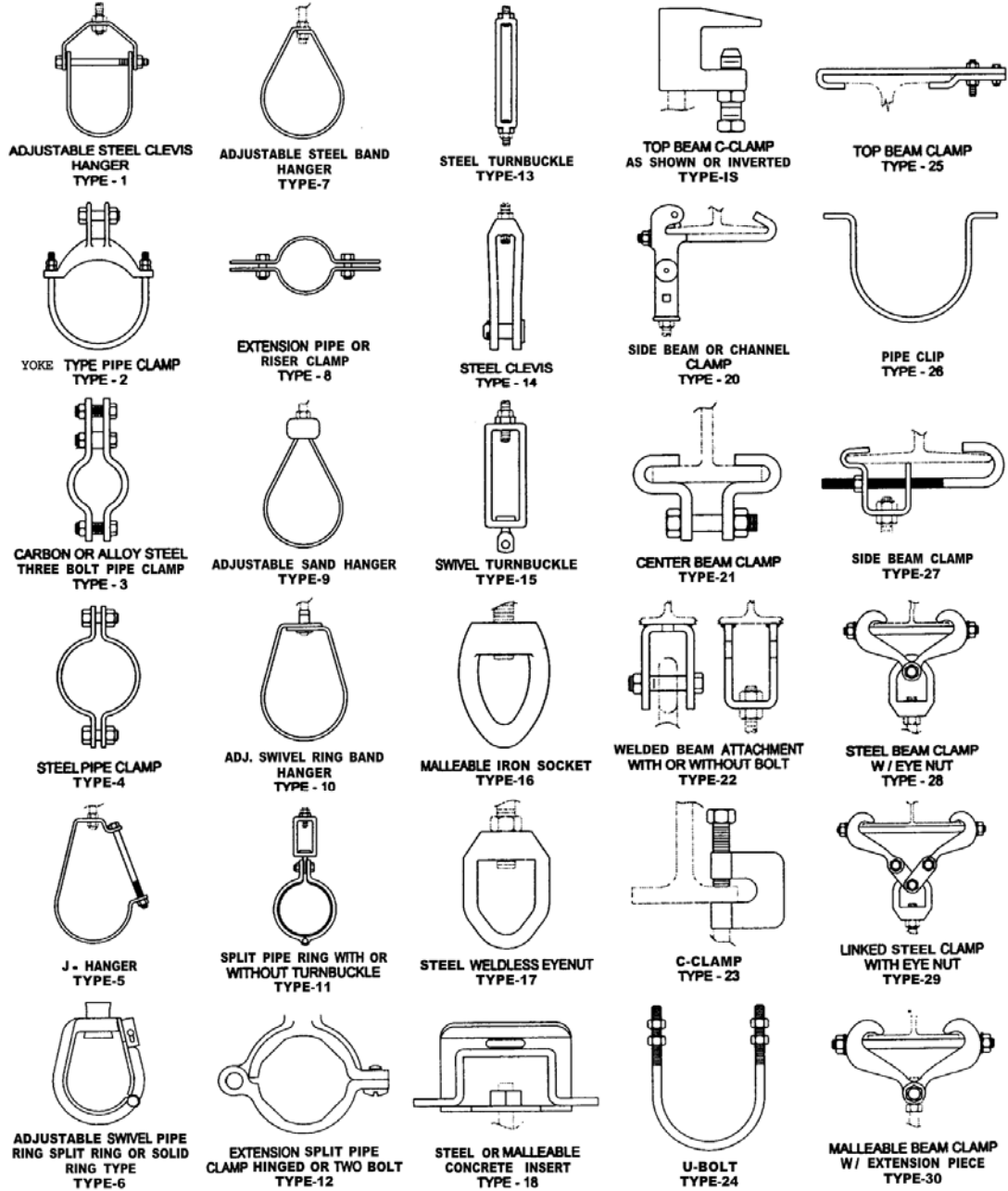
- c. PEX or PP
 - 1) NPS 1 and smaller: 32" with 3/8-inch rod.
 - 2) NPS 1-1/4 to NPS 3: 48" with 3/8-inch rod.
 - 3) NPS 3: 48" with 1/2-inch rod.

- 6. Provide supports for vertical piping every 10 feet.

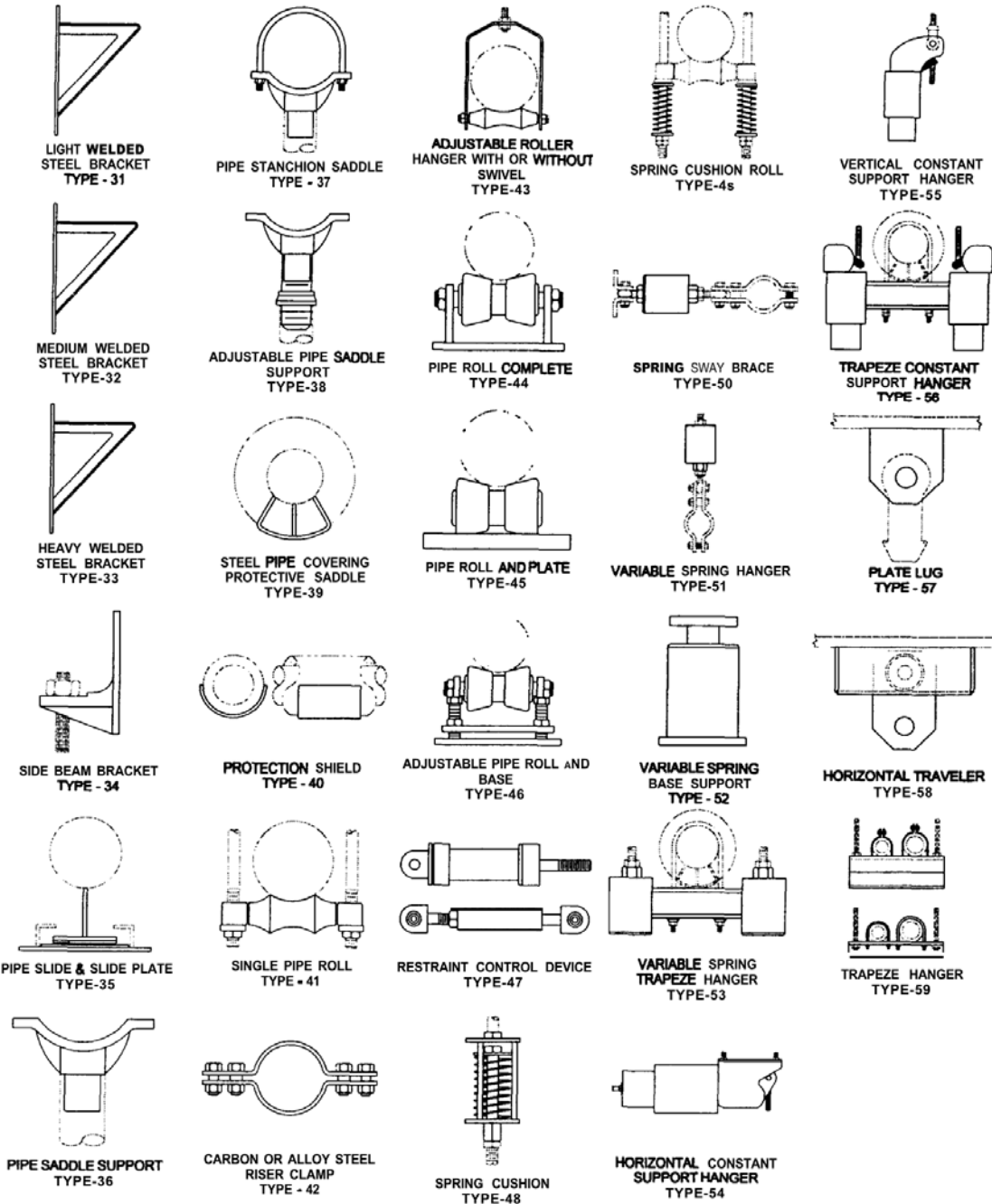
- E. Support vertical piping independently of connected horizontal piping. Support vertical pipes at base and at every floor. Wherever possible, locate riser clamps directly below pipe couplings or shear lugs.

- F. Place a hanger within 12 inches of each horizontal elbow.

3.8 MSS SP-69 REFERENCE



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END OF SECTION 23 05 29

SECTION 23 05 53 – IDENTIFICATION FOR MECHANICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Division 23 Section "Common Work Results for Mechanical"

1.2 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Valve numbering scheme. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.5 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with location of access panels and doors.
- C. Provide identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Terminology: Match schedules as closely as possible.
- B. Tag and description: Example: "EF-1 - Bathroom Exhaust"
- C. Equipment Markers: Custom Vinyl Decals with a clear polyester overlamine to endure outdoor conditions and are UV and scuff resistant. Decals shall be made of flexible vinyl with a permanent pressure-sensitive adhesive backing suitable for curved surfaces. Service temperature range of -40°F to 176°F.
- D. In addition to the equipment tag, equipment located above the ceiling that requires servicing shall be labeled on the ceiling grid using a labeling machine.

2.2 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Seton, Brady, or approved equal; preprinted, color-coded, with lettering indicating service, and showing direction of flow.
 - 1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 - 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length. Size of letters and length of color field per ASME A13.1.
 - 3. Pipes with OD, Including Insulation; Full-band snap-around pipe markers extending 360 degrees around pipe at each location.
 - 4. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
 - 5. Minimum length of color field and size of letters shall be in accordance with Plumbing Code requirements.
- B. Types:
 - 1. Self-adhesive type: Seton Opti-Code.
 - 2. Snap-around type: Seton Setmark.
 - 3. Wrap-around type: Seton Ultra-mark; PVF over-laminated polyester construction seals in and protects graphics; suitable for outdoor or harsh environments.

2.3 DUCT IDENTIFICATION DEVICES

- A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

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2.4 VALVE TAGS & SCHEDULES

- A. Valve Tags: Stamped or engraved 1-1/2" round with 1/4-inch letters for piping system legend and 1/2-inch black-filled numbers, with numbering scheme; 3/16" hole for fastener; Material: 19-gauge brass; Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
 - 2. Frame: aluminum.
 - 3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

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: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 22 or 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- A. Provide equipment markers on each item of scheduled equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
 - 1. Letter Size: Minimum 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

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for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
3. Locate markers where accessible and visible.

B. Equipment located above the ceiling that requires servicing shall be labeled on the ceiling using a labeling machine.

1. Ceilings 10 feet and lower: Letters shall be ¼" high, black.
2. Ceilings higher than 10 feet: Letters shall be 3/8" high, black.
3. Label all equipment above ceiling that requires servicing or access.
4. Locate labels on the ceiling grid, adjacent to the ceiling tile that provides the best access to the valve or item that requires servicing.

3.3 PIPING IDENTIFICATION

A. Provide manufactured pipe markers indicating service on each piping system.

1. Provide pipe markers to manufacturer's instructions.
2. Identify piping, concealed or exposed. Include service and flow direction.
3. Provide in clear view and align with axis of piping.
4. Locate identification at maximum 20 feet centers on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
5. At access doors and similar access points that permit view of concealed piping.
6. At least one per room.

B. Unions covered by insulation: Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

3.4 DUCT IDENTIFICATION

A. Locate duct markers as follows.

1. Ducts leaving mechanical rooms.
2. Ducts at riser shaft branches.

B. Provide duct markers with permanent adhesive on air ducts in the following color codes:

1. Green: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
3. Blue: For return ducts.
4. Red: For exhaust-, outside, or relief air ducts
5. Identify by system tag and type.

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6. Letter Size: Minimum 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.

C. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

A. Provide tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Mount valve schedule on wall in accessible location in each major equipment room. Provide (2) copies of valve schedules burned to a DVD or memory stick; Word or Excel format.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.7 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.8 CLEANING

A. Clean faces of mechanical identification devices.

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes Testing, Adjusting, & Balancing

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation of AABC agency and personnel, including a sample copy of the AABC "National Performance Guaranty." If not submitted within the timeframe specified, the engineer has the right to choose an AABC agency at the Contractor's expense.
- B. Examination Report: Provide a summary report of the examination review required in Section 3.1, if issues are discovered that may preclude the proper testing and balancing of the systems.

1.4 ACTION SUBMITTALS

- A. Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems." NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." SMACNA's TABB "HVAC Systems - Testing, Adjusting, and Balancing." TAB firm's forms approved by Architect. TABB "Contractors Certification Manual."

1.5 QUALITY ASSURANCE

- A. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

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PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper T&B 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. Note the locations of devices that are not accessible for testing and balancing.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that are properly separated from adjacent areas.
- E. Examine equipment performance data including fan and pump curves.
- F. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, clean permanent filters are installed, and equipment with functioning controls is ready for operation.
- G. Examine terminal units and verify that they are accessible and their controls are connected, configured by the controls contractor, and functioning.
- H. Examine strainers to verify that startup screens have been replaced with permanent screens and that all strainers have been cleaned.
- I. Examine control valves for proper installation and function.
- J. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- K. Examine air vents to verify that mechanical contractor has removed all air from all hydronic systems.

3.2 PREPARATION

- A. Prepare a T&B plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.

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B. Prepare system-readiness checklists, as described in the "AABC National Standards for Total System Balance," for use by systems installers in verifying system readiness for T&B. These shall include, at a minimum, the following:

1. Airside:

- a. Ductwork is complete with terminals installed.
- b. Volume and life-safety dampers are open and functional.
- c. Clean filters are installed.
- d. Fans are operating, free of vibration, and rotating in correct direction.
- e. Variable-frequency controllers' start-up is complete and safeties are verified.
- f. Automatic temperature-control systems are operational.
- g. Ceilings are installed.
- h. Windows and doors are installed.
- i. Suitable access to balancing devices and equipment is provided.

2. Hydronics:

- a. Piping is complete with terminals installed.
- b. Water treatment is complete.
- c. Systems are flushed, filled and air purged.
- d. Strainers are pulled and cleaned.
- e. Control valves are functioning per the sequence of operation.
- f. Shutoff and balance valves have been verified to be 100 percent open.
- g. Pumps are started and proper rotation is verified.
- h. Pump gage connections are installed directly at pump inlets and outlets flange or in discharge and suction pipe prior to valves or strainers.
- i. Variable-frequency controllers' start-up is complete and safeties are verified.
- j. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" and in this Section.
- B. 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.
- C. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain approved submittals and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

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- B. Prepare single-line schematic diagram of systems for the purpose of identifying HVAC components.
- 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. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check condensate drains for proper connections and functioning.
- H. Check for proper sealing of air-handling-unit components.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Set outside air, return air and relief air dampers for proper position that simulates minimum outdoor air conditions.
 - b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
 - c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
 - 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report any artificial loading of filters at the time static pressures are measured.
 - 3. 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.

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- 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.
 - 2. Adjust sub-main and branch duct volume dampers for specified airflow.
 - 3. Re-measure each submain and branch duct after all have been adjusted.

- C. Adjust air outlets and inlets for each space to indicated airflows
 - 1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
 - 2. Measure airflow at all inlets and outlets.
 - 3. Adjust each inlet and outlet for specified airflow.
 - 4. Re-measure each inlet and outlet after all have been adjusted.

- D. Verify final system conditions.
 - 1. Re-measure and confirm minimum outdoor air, return and relief airflows are within design. Readjust to design if necessary.
 - 2. Re-measure and confirm total airflow is within design.
 - 3. Re-measure all final fan operating data, rpms, volts, amps, static profile.
 - 4. Mark all final settings.
 - 5. Test system in economizer mode. Verify proper operation and adjust, if necessary. Measure and record all operating data.
 - 6. Record final fan-performance data.

3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and any manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

- B. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

- C. Verify that hydronic systems are ready for testing and balancing:
 - 1. Check liquid level in expansion tank.
 - 2. Check that makeup water has adequate pressure to highest vent.
 - 3. Check that control valves are in their proper positions.
 - 4. Check that air has been purged from the system.
 - 5. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
 - 6. Verify that motor starters are equipped with properly sized thermal protection.

3.7 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Adjust pumps to deliver total design gpm.
1. Measure total water flow.
 - a. Position valves for full flow through coils.
 - b. Measure flow by main flow meter, if installed.
 - c. If main flow meter is not installed determine flow by pump total dynamic head (TDH) or exchanger pressure drop.
 2. Measure pump TDH as follows:
 - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
 - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
 - c. Convert pressure to head and correct for differences in gauge heights.
 - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - e. With all valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.
 3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.
- B. Adjust flow measuring devices installed in mains and branches to design water flows.
1. Measure flow in main and branch pipes.
 2. Adjust main and branch balance valves for design flow.
 3. Re-measure each main and branch after all have been adjusted.
- C. Adjust flow measuring devices installed at terminals for each space to design water flows.
1. Measure flow at all terminals.
 2. Adjust each terminal to design flow.
 3. Re-measure each terminal after all have been adjusted.
 4. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
 5. Perform temperature tests after all flows have been balanced.

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- D. For systems with pressure-independent valves at the terminals:
 - 1. Measure differential pressure and verify that it is within manufacturer's specified range.
 - 2. Perform temperature tests after all flows have been verified.
- E. For systems without pressure-independent valves or flow measuring devices at the terminals:
 - 1. Measure and balance coils by either coil pressure drop or temperature method.
 - 2. If balanced by coil pressure drop, perform temperature tests after all flows have been verified.
- F. Verify final system conditions as follows:
 - 1. Re-measure and confirm that total water flow is within design.
 - 2. Re-measure all final pump operating data, TDH, volts, amps, static profile.
 - 3. Mark all final settings.
- G. Verify that all memory stops have been set

3.8 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Adjust the variable-flow hydronic system as follows:
 - 1. Verify that the differential-pressure sensor is located per the contract documents.
 - 2. Determine if there is diversity in the system.
- B. For systems with no diversity:
 - 1. Follow procedures outlined in "Procedures for Constant-Flow Hydronic Systems" Article.
 - 2. Prior to verifying final system conditions, determine the system differential-pressure set point.
 - 3. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
 - 4. Mark all final settings and verify that all memory stops have been set.
- C. For systems with diversity:
 - 1. Determine diversity factor.
 - 2. Simulate system diversity by closing required number of control valves, as approved by the design engineer.
 - 3. Follow procedures outlined in "Procedures for Constant-Flow Hydronic Systems" Article.
 - 4. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance the terminals that were just opened.

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5. Prior to verifying final system conditions, determine the system differential-pressure set point.
6. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
7. Mark all final settings and verify that all memory stops have been set.

3.9 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. Minimum Outside Air: Zero to plus 10 percent.
 4. Heating-Water Flow Rate: Plus or minus 10 percent.
 5. Cooling-Water Flow Rate: Plus or minus 10 percent.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.10 FINAL TEST & BALANCE REPORT

- A. The report shall be a complete record of the HVAC system performance, including conditions of operation, items outstanding, and any deviations found during the T&B process. The final report also provides a reference of actual operating conditions for the owner and/or operations personnel. All measurements and test results that appear in the reports must be made on site and dated by the AABC technicians or test and balance engineers.
- B. The report must be organized by systems and shall include the following information as a minimum:
 1. Title Page:
 - a. Company address
 - b. Company telephone number
 - c. Project identification number
 - d. Location
 - e. Project Architect
 - f. Project Engineer
 - g. Project Contractor
 - h. Project number
 - i. Date of report
 2. Table of Contents.
 3. AABC National Performance Guaranty.

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4. Report Summary:
 - a. The summary shall include a list of items that do not meet design tolerances, with information that may be considered in resolving deficiencies.
5. Instrument List:
 - a. Type.
 - b. Manufacturer.
 - c. Model.
 - d. Serial Number.
 - e. Calibration Date.
6. T&B Data: Provide test data for specific systems and equipment as required by the most recent edition of the "AABC National Standards."

END OF SECTION 23 05 93

SECTION – 23 07 00 - MECHANICAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 7 for firestopping materials and requirements for penetrations through fire and smoke barriers.
 - 2. Division 23 Section "Common Work Results for Mechanical"
 - 3. Division 23 Section "Hangers and Supports for Piping and Equipment" for pipe insulation shields and protection saddles.

1.2 SUMMARY

- A. This Section includes insulation and related components.

1.3 ACTION SUBMITTALS

- A. Product Data: Identify thermal conductivity, Greenguard Certification, thickness, and jackets (both factory and field applied, if any), for each type of product indicated. For adhesives and sealants, provide documentation including printed a statement of VOC content.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
- C. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

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1.5 DELIVERY, STORAGE, AND HANDLING

- A. Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.
- B. All of the insulation materials and accessories covered by this specification shall be delivered to the job site and stored in a safe, dry place with appropriate labels and/or other product identification.
- C. Store tapes, adhesives, mastics, cements, and insulation materials in ambient conditions in accordance with the recommendations of the manufacturer.
- D. Follow manufacturer's recommended handling practices.
- E. The contractor shall use whatever means are necessary to protect the insulation materials and accessories before, during, and after installation. No insulation material shall be installed that has become damaged in any way. The contractor shall also use all means necessary to protect work and materials installed by other trades.
- F. Fiber Glass and Mold: Contractor shall take precaution to protect insulation. Any fiber glass insulation that becomes wet or torn should be replaced at no additional cost. Air handling insulation used in the air stream must be discarded if exposed to water.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields. Coordinate clearance requirements with other trades for insulation application.
- B. Schedule insulation application after testing systems. Insulation application may begin on segments of systems that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Certainteed
 - 2. Knauf
 - 3. Owens-Corning
 - 4. John Mansville
 - 5. Armstrong
 - 6. Aeroflex USA

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7. Nomaco K-Flex
8. Pabco.

2.2 PIPING INSULATION MATERIALS

A. General

1. Supply fiber glass products that have achieved GREENGUARD Children & Schools Certification.
2. Surface Burning Characteristics: Insulation and related materials shall have surface burning characteristics determined by test performed on identical products per ASTM E 84 mounted and installed as per ASTM E 2231. All testing shall be performed by a testing and inspecting agency acceptable to authorities having jurisdiction. Insulation, jacket materials, adhesives, mastics, tapes and cement material containers shall be labeled with appropriate markings of applicable testing and inspecting agency. Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
3. Supply fiber glass products that are manufactured using a certified 25 % minimum recycled content.

- B. Provide thermal hanger shields as specified in Section 23 05 29 "Hangers and Supports for Piping and Equipment".

C. Glass Fiber:

1. Knauf 1000° Pipe Insulation with ECOSE Technology meeting ASTM C547 Type IV Grade A, ASTM C585, and ASTM C795; rigid, molded, noncombustible per ASTM E136; k value: ASTM C335, 0.23 at 75°F mean temperature. Maximum Service Temperature: 1000°F, or Johns Manville's Micro-Lok[®] HP meeting ASTM C547, Type I, maximum service temperature of 850°F meeting the other requirements. Vapor Retarder Jacket: ASJ/SSL conforming to ASTM C1136 Type I, secured with self-sealing longitudinal laps and butt strips.
2. PVC Fitting Covers: The Proto Fitting Cover System or Johns Manville Zeston[®] polyvinyl chloride (PVC) parts shall consist of one piece and two piece pre-molded high impact UV-resistant PVC fitting covers with fiberglass inserts and accessories, which include elbows, tee/valves, end caps, mechanical line couplings, and specialty fittings. Fittings shall be made of Zeston[®] or LoSMOKE[®] grade PVC, 25/50 rated per ASTM E-84. Thermal Value of fiberglass insert: K value of 0.26 at 75°F; resistance to fungi and bacteria. (ASTM G 21, ASTM G 22): does not promote growth of fungi or bacteria.

- D. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

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3. Materials shall have a maximum thermal conductivity of 0.27 Btu-in/h-ft²- °F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.
 4. Materials shall have a maximum water vapor transmission of 0.08 perm-inches when tested in accordance with ASTM E 96, Procedure-A, latest revision.
 5. Materials shall have a flame spread index of less than 25 and a smoke developed index of less than 50 when tested in accordance with ASTM E 84, latest revision.
 6. Provide Armaflex WB finish for outdoor exposed piping.
- E. Calcium Silicate Insulation: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I. IIG Thermo-12 Gold, or approved equal.
- F. Closed Cell Pipe Insulation: Pittsburgh Corning Foamglas, or approved equal; a lightweight, rigid insulating material composed of millions of completely sealed glass cells, each an insulating space. ASTM C 552-00 "Specification for Cellular Glass Thermal Insulation" operating temperatures from -450°F to +900°F; water permeability 0.00 perm-inch.
- G. Pipe & Tank Insulation: Glass Fiber, Knauf with ECOSE Technology or equivalent; semi-rigid, limited combustible meeting requirements of NRC 1.36; ASTM C 795 and MIL-I-24244 C; k value: ASTM C 177, 0.25 at 75°F mean temperature. Maximum Service Temperature: 850°F. Compressive Strength: not less than 150 PSF @ 10% deformation for 2 inch thickness per ASTM C 165. Vapor Retarder Jacket: ASJ conforming to ASTM C 1136 Type II. Johns Manville Micro-Flex[®] Large Diameter Pipe and Tank Wrap meeting ASTM C1393, Type III. Limited combustible meeting k value: ASTM C 177, 0.25 at 75°F mean temperature. Maximum Service Temperature: 850°F. Compressive Strength: not less than 150 PSF @ 10% deformation for 2 inch thickness per ASTM C 165. Vapor Retarder Jacket: ASJ conforming to ASTM C 1136 Type II
- H. Removable/reusable Insulation Blankets: Auburn Manufacturing EverGreen Cut 'n Wrap, or approved equal; engineered insulating composite with a fiberglass inner core and high-performance polymer coated woven glass fiber fabric outer layer on both sides. Kits contain a 4'x 8' modularized blanket rated to 500°F and a roll of double sided hook and loop fastener making onsite fabrication of removable/reusable insulation blankets quick and easy. Up to 500°F; Weight, oz/ft² 7.65; Effective Thickness, in. 1.25 ± 0.25; Surface Burning Characteristics: Does not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E-84. Materials shall have a maximum thermal conductivity of 0.372 Btu-in/h-ft²- °F at a 100°F mean temperature when tested in accordance with ASTM C335.
- 2.3 FIELD-APPLIED JACKETS FOR PIPING
- A. General: ASTM C 921, Type 1, unless otherwise indicated.
 - B. PVC: Johns Manville's Zeston[®] PVC fittings, jacketing, and accessories or Proto Corporation 25/50 or Indoor/Outdoor, UV-resistant fittings, jacketing and accessories, white. Fitting cover

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system consists of pre-molded, high-impact PVC materials with fiber glass inserts. Fiber glass insert has a thermal conductivity (k value) of 0.26 at 75° F mean temperature. Closures: stainless steel tacks, matching PVC tape, or PVC adhesive per manufacturer's recommendations.

- C. Aluminum Jacket: Factory cut and rolled to required size. Comply with ASTM B 209, 3003 alloy, and H-14 temper. Finish and Thickness: Corrugated finish, 0.010 inch thick. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and Kraft paper. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.

2.4 DUCTWORK INSULATION MATERIALS

- A. Flexible Fiber Glass Blanket: Johns Manville's Microlite® EQ Duct Wrap or Knauf Friendly Feel® Duct Wrap with ECOSE Technology meeting ASTM C553 Types I, II and III, and ASTM C1290; GREENGUARD certified; flexible, limited combustible; k value: ASTM C177, 0.29 at 75°F mean temperature. Maximum Service Temperature: faced: 250°F; unfaced: 350°F. Vapor Retarder Jacket: FSK conforming to ASTM C1136 Type II. Installation: Maximum allowable compression is 25%. Securement: Secured in place using outward cinching staples in combination with appropriate pressure-sensitive aluminum foil or PSK tape, or in combination with glass fabric and vapor retarder mastic. Density: concealed areas: Minimum 0.75 PCF; exposed areas: Minimum 1.0 PCF.
- B. Rigid Fiber Glass Board: Johns Manville's 817 Series Spin-Glas® or Knauf Insulation Board with ECOSE Technology meeting ASTM C 612 Type IA and IB; rigid. Maximum Service Temperature: 450°. Density: Minimum 6 PCF; k value: ASTM C177, 0.22 at 75°F mean temperature. Vapor Retarder Jacket: ASJ conforming to ASTM C1136 Type I, or FSK or PSK conforming to ASTM C1136 Type II in combination with protective jacket where necessary.

2.5 ACCESSORY MATERIALS

- A. Accessory materials installed as part of insulation work under his section shall include (but not be limited to):
 - 1. Closure Materials - Butt strips, bands, wires, staples, mastics, adhesives; pressure-sensitive tapes.
 - 2. Adhesive: As recommended by insulation material manufacturer. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated
 - 3. Support Materials - Hanger straps, hanger rods, saddles, support rings
- B. All accessory materials shall be installed in accordance with manufacturer's instructions.
- C. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION & PREPARATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application. Verify that systems to be insulated have been tested and are free of defects. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.
- D. Ensure that all pipe and fitting surfaces over which insulation is to be installed are clean and dry. Ensure that insulation is clean, dry, and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation. Ensure that pressure testing of piping and fittings has been completed prior to installing insulation.

3.2 GENERAL APPLICATION REQUIREMENTS

- A. Provide insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout, including the length of ducts and fittings, valves, and specialties.
- B. Provide insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each system as specified in insulation system schedules.
- C. Provide accessories compatible with insulation materials and suitable for the service. Provide accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Provide insulation with longitudinal seams at top and bottom of horizontal pipe runs and equipment.
- E. Provide 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. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- H. Keep insulation materials dry during application and finishing.

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- I. Provide insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- J. Provide insulation over fittings, valves, and specialties, with continuous thermal and least number of joints practical.
- K. 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 specialties 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.
- L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- M. Provide insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.3 PIPE AND DUCTWORK PENETRATIONS

- A. Insulation Installation at Roof or Aboveground Exterior Wall Penetrations: Install insulation continuously through penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof/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 roof/wall flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof/wall flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Penetrations:
1. Fire Dampers: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 2. Pipe or duct penetrations (no fire damper): Install insulation continuously through penetrations of fire-rated walls and partitions. Comply with requirements in Division 7 for firestopping and fire-resistive joint sealers.

3.4 INSTALLATION OF PIPING INSULATION

- A. Metal shields shall be installed between hangers or supports and the piping insulation. Provide in accordance with Section 23 05 29.
- 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

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- diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
- C. Insulate instrument connections for specialties (examples: thermometers, sensors, etc.) on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at fittings and equipment that require servicing and locations with service requirements.
- E. Locate seams in the least visible location.
- F. Insulation installed on piping operating below ambient temperatures must have a continuous vapor retarder. All joints, seams and fittings must be sealed. On systems operating above ambient, the butt joints should not be sealed.
- G. Flexible Elastomeric Insulation
1. Seal longitudinal seams and end joints with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
 2. Insulation Installation on Pipe Flanges: Install pipe insulation to outer diameter of pipe flange. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation. Secure insulation to flanges and seal seams with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

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3. Insulation Installation on Pipe Fittings and Elbows: Install mitered sections of pipe insulation. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
4. Insulation Installation on Valves and Pipe Specialties: Install preformed valve covers manufactured of same material as pipe insulation when available. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. Install insulation to flanges as specified for flange insulation application. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
5. After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating. Prior to applying the finish, the insulation shall be wiped clean with denatured alcohol. The finish shall not be tinted. To insure good adhesion, the temperature should be above 50 °F during application and drying. Outdoor exposed piping shall have the seams located on the lower half of the pipe.
6. Outdoor exposed piping shall be painted with two coats of Armaflex WB Finish. Prior to applying the Finish, the insulation shall be wiped clean with denatured alcohol. The Finish shall not be tinted. Outdoor exposed piping shall have the seams located on the lower half of the pipe.

3.5 INSTALLATION OF DUCTWORK INSULATION

A. Flexible Fiberglass Blanket Insulation Installation:

1. Secure with adhesive and insulation pins.
2. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
3. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
4. Firmly butt all joints.
5. Where vapor retarder performance is required, all penetrations and damage to the facing shall be repaired using pressure-sensitive tape matching the facing, or mastic prior to system startup. Pressure-sensitive tapes shall be a minimum 3 inches wide and shall be applied with moving pressure using a squeegee or other appropriate sealing tool. Closure shall have a 25/50 Flame Spread/Smoke Developed Rating per UL 723. The longitudinal seam of the vapor retarder must be overlapped a minimum of 2 inches.
6. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

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- b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Insulation shall be additionally secured to the bottom of rectangular ductwork over 24 inches wide using mechanical fasteners on 18-inch centers. Care should be exercised to avoid over-compression of the insulation during installation.
 - d. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - e. Do not over-compress insulation during installation. Install Duct Wrap using manufacturer's stretch-out tables to obtain specified R-value using a maximum compression of 25%.
 - f. Impale insulation over pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
7. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 8. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 9. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over-compress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and

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- inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
5. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- C. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
1. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 2. Install vapor stops for ductwork and plenums operating below 50°F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
- D. Fire-rated insulation system installation: Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating. Insulate duct access panels and doors to achieve same fire rating as duct.

3.6 INSTALLATION OF EQUIPMENT/ TANK INSULATION

A. Fiber Glass

1. Apply insulation to the equipment surface with joints firmly butted and as close as possible to the equipment surface. Insulation shall be secured as required with mechanical fasteners or banding material. Fasteners shall be located a maximum of 3" from each edge and spaced no greater than 12" on center.
2. For below ambient systems, vapor retarder jacketing shall overlap a minimum of 2" at all seams and be sealed with appropriate pressure-sensitive tape or mastic. All penetrations and facing damage shall be covered with a minimum 2" overlap of tape or mastic.

B. Flexible Elastomeric:

1. Install insulation over entire surface of tanks and vessels.
2. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
3. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps: Insulate chilled water pumps by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints that do not leave raw ends of insulation exposed. Bottom and sides shall be banded to form a rigid

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housing that does not rest on the pump. Joints between top cover and sides shall fit tightly. The top cover shall have a joint forming a female shiplap joint on the side pieces and a male joint on the top cover, making the top cover removable. Two coats of Class I adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line of the removable sections and penetrations.

3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturers recommended adhesive. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.8 FINISHES

- A. Pipe Insulation with ASJ, Glass-Cloth, or other paintable jacket material: Paint jacket with paint system identified below and as specified in Division 9.
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

3.9 FIELD QUALITY CONTROL

- A. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

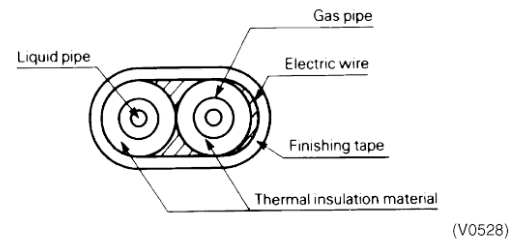
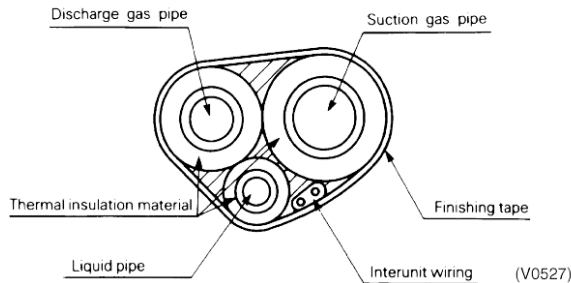
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3.10 PIPING INSULATION APPLICATION SCHEDULE

- A. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements. For piping systems not indicated, insulate to with a similar thickness and type as those specified.
- B. All cold surfaces that may “sweat” must be insulated. Vapor barrier must be maintained, insulation shall be applied with a continuous, unbroken moisture and vapor seal. All hangers, supports, anchors, or other projections that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation.
- C. For above-ambient services, do not install insulation to the following: testing agency labels and stamps, nameplates, and cleanouts.
- D. Insulation thicknesses and installations shall meet or exceed the requirements of the local energy code, or thicknesses indicated, whichever is of superior insulating performance. If piping type is omitted from list below, provide insulation per energy code or as per similar duty.
- E. AC pan drain or other cold drain piping: Flexible Elastomeric, ½” thickness.
- F. Refrigerant suction or hot gas piping: Flexible Elastomeric, 1.5” thickness.
- G. VRF:

3.2.2 Heat Recovery Series

- Suction, discharge gas piping, and liquid piping must be insulated.
- Example of thermal insulation work:
- 3 piping section (between outdoor unit and BS unit)
- 2 piping section (between BS unit and indoor unit)



- H. Condenser Water: No insulation required.

3.11 EQUIPMENT INSULATION

- A. For equipment not indicated, insulate to with a similar thickness and type as those specified.

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- B. Install insulation over entire surface of tanks and vessels. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive. Seal longitudinal seams and end joints.
- C. For Equipment insulation exposed in mechanical rooms or subject to mechanical abuse, finish with minimum 0.020 inch thick PVC jacketing or metal or laminated self-adhesive water and weather seals. All other insulation shall be finished as appropriate for the location and service or as specified on the drawings.
- D. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.
- E. Omit insulation from the following, except for cold surfaces, which shall be provided with removable covers:
 - 1. Hot water expansion tanks
 - 2. Hot water pumps
 - 3. Vibration-control devices.
 - 4. Testing agency labels and stamps.
 - 5. Nameplates and data plates.
 - 6. Manholes, hand holes, or cleanouts.
- F. Removable Covers for Maintenance Access: Construct insulation on parts of equipment such as chilled water pumps; or other equipment which must be opened periodically for maintenance or repair, so insulation can be removed and replaced without damage. Use ¾" flexible elastomeric insulation.
- G. Cooling & heating system expansion tanks, chemical feed tanks, buffer tanks and similar equipment: same as water piping.
- H. Air separators, low loss headers, and similar equipment: same as water piping.
- I. Heating hot-water heat exchangers; steam-to-water converters; deaerators (not factory insulated); Insulation Material: Pipe & Tank Insulation, 2" thickness.
- J. Hot equipment not factory insulated, Examples: steam flash-tank, flash-separator, moisture-separator, and blow-off-tank insulation shall be one of the following:
 - 1. Pipe & Tank Insulation: 2" thick.

3.12 DUCT SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section. For duct systems not indicated, insulate to with a similar thickness and type as those specified.
- B. Insulation thicknesses and installations shall meet or exceed the requirements of the local energy code, or thicknesses indicated, whichever is of superior insulating performance.

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- C. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
1. Metal ducts with duct liner.
 2. Factory-insulated flexible ducts.
 3. Factory-insulated plenums, casings, and access doors.
 4. Flexible connectors.

3.13 DUCT AND PLENUM APPLICATION SCHEDULE

- A. Supply Ducts: Flexible Fiber Glass Blanket;
1. Ventilated Attic: R-6, 2" thickness.
 2. Concealed or Unconditioned Space: R-6, 1.5" thickness.
 3. Return Air Plenums: None
 4. Exposed to Conditioned Space: None
- B. ERU Ductwork
1. SA: None
 2. RA: None
 3. EA: Yes, see below.
 4. OA: Yes, see below.
- C. Concealed or in mechanical rooms: outside air intake, relief, or exhaust ducts and plenums [within 20 feet of exterior]: Flexible Fiber Glass Blanket; R-8, 2" thickness.
- D. Exposed outside air intake, relief, or exhaust ducts and plenums [within 20 feet of exterior]: Rigid Fiber Glass Board; R-8, 2" thickness.
- E. Return ducts within conditioned space: None required.

END OF SECTION 23 07 00

SECTION 23 09 00 – DIRECT DIGITAL CONTROL (DDC) SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide all labor, materials, equipment, and programming necessary to integrate the new equipment with the existing Siemens Apogee building automation system.
- B. Provide all labor, materials, equipment, and service necessary for an extension of the existing/addition to the existing Siemens Apogee building automation system.
- C. Project scope shall include but not necessarily be limited to the following:
 - 1. Integration of the new energy recovery units and associated motorized dampers with the existing Siemens Apogee control system for scheduled operation, monitoring, and alarming.
 - 2. Integration of the new tower and tower controls with the existing Siemens Apogee building automation system for scheduled operation, monitoring, and alarming
 - 3. Integration of the Daikin water cooled VRF controls with the existing Siemens Apogee building automation system for scheduling, monitoring, and alarming (refer to Section 238129).
- D. The Controls Contractor's work shall consist of the provision of all labor, materials, special tools, equipment, enclosures, power supplies, software, software licenses, project-specific software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, submittals, testing, verification, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, warranty, specified services and items required by the Contract that are required for the functional turn-key operation of the complete and fully functional Controls Systems. Documents are diagrammatic only. Equipment and labor not specifically referred to herein or on the plans, which are required to meet the functional intent, shall be provided without additional cost to the Owner.
- E. Related Sections include the following:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
 - 2. Division 23 Section "Common Work Results for Mechanical"
 - 3. Division 23 Sections with controller interfaces shall be integrated with the work of this Section.
 - 4. Division 23 Section "Testing, Adjusting, and Balancing"
 - 5. Division 26

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product include the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation, operation and maintenance instructions including factors effecting performance.
5. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.
6. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
7. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.

B. Shop Drawings:

1. General Requirements:
 - a. Include cover drawing with Project name, location, Owner, Architect, Contractor and issue date with each Shop Drawings submission.
 - b. Include a drawing index sheet listing each drawing number and title that matches information in each title block.
 - c. Prepare Drawings using CAD.
2. Schematic drawings for each controlled HVAC system indicating the following:
 - a. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.
 - b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
 - c. A graphic showing location of control I/O in proper relationship to HVAC system.
 - d. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
 - e. Unique identification of each I/O that shall be consistently used between different drawings showing same point.

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- f. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to DDC controllers.
- g. Narrative sequence of operation.
- h. Graphic sequence of operation, showing all inputs and output logical blocks.

C. System Description:

- 1. Full description of DDC system architecture, network configuration, operator interfaces and peripherals, servers, controller types and applications, gateways, routers and other network devices, and power supplies.
- 2. Complete listing and description of each report, log and trend for format and timing and events which initiate generation.
- 3. System and product operation under each potential failure condition including, but not limited to, the following:
 - a. Loss of power.
 - b. Loss of network communication signal.
 - c. Loss of controller signals to inputs and outpoints.
 - d. Operator workstation failure.
 - e. Server failure.
 - f. Gateway failure.
 - g. Network failure
 - h. Controller failure.
 - i. Instrument failure.
 - j. Control damper and valve actuator failure.
- 4. Complete bibliography of documentation and media to be delivered to Owner.
- 5. Description of testing plans and procedures.
- 6. Description of Owner training.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For DDC system to include in emergency, operation and maintenance manuals.
 - 1. In addition to items specified in Division 1, include the following:
 - a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format.
 - b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
 - c. As-built versions of submittal Product Data.
 - d. Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.

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- e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control and changing set points and variables.
- f. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
- g. Engineering, installation, and maintenance manuals that explain how to:
 - 1) Design and install new points, panels, and other hardware.
 - 2) Perform preventive maintenance and calibration.
 - 3) Debug hardware problems.
 - 4) Repair or replace hardware.
- h. Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.
- i. Backup copy of graphic files, programs, and database on electronic media such as DVDs.
- j. List of recommended spare parts with part numbers and suppliers.
- k. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
- l. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.
- m. Licenses, guarantees, and warranty documents.
- n. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
- o. Owner training materials.

1.4 QUALITY ASSURANCE

- A. All products used in this project installation shall be new and currently under manufacture and shall have been applied in similar installations for a minimum of two years. This installation shall not be used as a test site for any new products unless explicitly approved by the owner's representative in writing. Spare parts shall be available for at least five years after completion of this contract.
- B. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the temperature control system manufacturer. Use only employees who are qualified, skilled, experienced, manufacturer trained and familiar with the specific equipment, software and configurations to be provided for this Project.
- C. Provide a complete, neat and workmanlike installation.

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- D. All work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local, state, and federal authorities. Such codes, when more restrictive, shall take precedence over these plans and specifications.
- E. 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.
- F. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."
- G. Comply with ASHRAE 135 for DDC system control components.
- H. The contractor shall protect all work and material from damage by his/her work or employees. The contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The contractor shall protect any material that is not immediately installed. The contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

1.5 CONTRACTOR QUALIFICATIONS

- A. Qualified Bidders: System shall be as manufactured, installed and serviced by:
 - 1. Siemens
- B. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
- C. The above list of manufacturers applies to operator workstation software, controller software, the custom application programming language, and controllers. All other products specified herein (e.g., sensors, valves, dampers, and actuators) need not be manufactured by the above manufacturers.
- D. Longevity: The Facilities Management System contractor shall have a minimum of ten years experience installing, and servicing computerized Building Automation Systems (BAS). All subcontractors utilized by the BAS contractor shall have a minimum of five-year experience within their appropriate trades.
- E. Past Projects: The BAS contractor shall have completed a minimum of ten projects within the last five years that are at least equal in dollar value and scope to this project. A list of similar projects, dollar volume, scope, contact name and contact number shall be provided by the BAS contractor if asked for by the owner.
- F. Personnel, Coverage and Response Capabilities: The BAS contractor shall have a minimum of ten full time electronic service personnel within a 120 mile radius of the project location. One of the five full time electronic service personnel must work within a 60-mile radius of the project location.

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- G. The BAS contractor shall have an established 24-hour emergency service organization. A dedicated telephone number shall be provided to the owner for requesting emergency service. A maximum of four hour, electronic service technician on sight, response time shall be guaranteed by the BAS contractor.

1.6 COORDINATION

- A. Where the mechanical work will be installed in close proximity to, or will interfere with, work of other trades, the contractor shall assist in working out space conditions to make a satisfactory adjustment. If the contractor installs his/her work before coordinating with other trades, so as to cause any interference with work of other trades, the contractor shall make the necessary changes in his/her work to correct the condition.
- B. Coordinate details of telephone line, internet service provider, and associated requirements.
- C. Coordinate and schedule work with all other work in the same area, or with work that is dependent upon other work, to facilitate mutual progress.
- D. Coordinate location of thermostats and other exposed control sensors with plans and room details before installation.
- E. Coordination with controls specified in other sections or divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the controls system specified in this section. These controls shall be integrated into the system and coordinated by the contractor.
- F. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.
- G. HVAC Contractor:
 - 1. Installation of immersion wells and sockets, along with associated shut-off cocks.
 - 2. Installation of pipe-mounted control devices.
- H. Testing and Balancing Contractor:
 - 1. The contractor shall furnish a single set of all tools necessary to interface to the control Alsystem for test and balance purposes.
 - 2. The contractor shall provide training in the use of these tools. This training will be planned for a minimum of 4 hours.
 - 3. In addition, the contractor shall provide a qualified technician to assist in the test and balance process, until the first 20 terminal units are balanced.
 - 4. The tools used during the test and balance process shall be returned at the completion of the testing and balancing.
- I. Electrical Subcontractor: Complying with the principle of "unit responsibility" all electrical work for automatic controls, except as otherwise specified, or shown on the electrical drawings

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shall be included in Division 23. Electrical work shall, in general, comply with the following, unless otherwise directed by Division 26:

1. Power wiring.
 2. All control wiring shown on electric plans such as unit heater line-voltage room thermostats.
 3. Duct smoke detectors required for air handler shutdown are supplied under Division 26. Coordinate required length of sampling tube, for full span of ductwork. The contractor shall connect the DDC system to the auxiliary contacts provided on the smoke detector for system safeties and to provide alarms to the DDC system.
 4. All electrical work shall comply with the N.E.C. and local electrical codes.
 5. All safety devices shall be wired through both hand and auto positions of motor starting device to insure 100% safety shut-off.
 6. The motor starter supplier shall provide auxiliary contacts as required for interlock by BAS Contractor; the supplier shall estimate an allowance of at least one auxiliary contract per starter.
- J. Coordinate with controls specified in other sections of divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the BAS contractor as follows:
1. All communication media and equipment shall be provided as specified hereinafter.
 2. Each supplier of a control product is responsible for the configuration, programming, start-up, and testing of that product to meet the sequences of operation described in this section.
 3. The BAS contractor shall coordinate and resolve any incompatibility issues that arise between the control products provided under this section and those provided under other sections or divisions of this specification.
 4. The BAS contractor is responsible for providing all controls described in the contract documents regardless of where within the contract documents these controls are described.
 5. The contractor is responsible for the interface of control products provided by multiple suppliers regardless of where this interface is described within the contract documents.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.
- B. System Software: Update to latest version of software at Project completion.

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1.8 WARRANTY

- A. Refer to Division 1 Requirements.
- B. At the end of the final start-up, testing, and commissioning phase, if equipment and systems are operating satisfactorily to the engineer, the engineer shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of acceptance shall be the start of warranty. All work shall have a single warranty date, even when the owner has received beneficial use due to an early system start-up.
- C. All components, system software, and parts supplied by the BAS contractor shall be guaranteed against defects in materials and workmanship for one year from acceptance date. The BAS contractor at no charge shall furnish Labor to repair, reprogram, or replace components during the warranty period. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software disks. The Contractor shall respond to the owner's request for warranty service within 24 hours during normal business hours.
- D. Provide remote service diagnostic monitoring from the nearest service location. At the request of the owner, a service diagnostic call will be made to troubleshoot and resolve (if possible) any reported system complaints. The owner will provide a dedicated telephone line for connection to the system.

PART 2 - PRODUCTS

2.1 COMMUNICATION

- A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135, BACnet.
- B. Install new wiring and network devices as required to provide a complete and workable control network.
- C. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.
- D. Internetwork operator interface and value passing shall be transparent to internetwork architecture.
- E. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.

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- F. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies specified in Section 23 09 93. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.
- G. Workstations, Building Control Panels, and Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated device via the internetwork. The system shall automatically adjust for daylight saving and standard time as applicable.
- H. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.

2.2 UNITARY CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
 - 1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
 - 2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
 - 3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
 - 4. Enclosure: Dustproof rated for operation at 32 to 120 deg F.

2.3 SENSING DEVICES

- A. Where feasible, provide the same sensor type throughout the project. Avoid using transmitters unless absolutely necessary.
- B. Thermistors: Precision thermistors may be used in applications below 200 degrees F. Sensor accuracy over the application range shall be 0.36 degree F or less between 32 to 150 degrees F. Stability error of the thermistor over five years shall not exceed 0.25 degree F cumulative. A/D conversion resolution error shall be kept to 0.1 degree F. Total error for a thermistor circuit shall not exceed 0.5 degree F.
- C. Transmitters: Provide transmitters with 4 to 20 mA or 0 to 10 VDC linear output scaled to the sensed input. Transmitters shall be matched to the respective sensor, factory calibrated, and

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sealed. Size transmitters for an output near 50 percent of its full-scale range at normal operating conditions. The total transmitter error shall not exceed 0.1 percent at any point across the measured span. Supply voltage shall be 12 to 24 volts AC or DC. Transmitters shall have non-interactive offset and span adjustments. For temperature sensing, transmitter drift shall not exceed 0.03 degrees F a year.

- D. Current Transducers: Provide current transducers to monitor motor amperage, unless current switches are shown on design drawings or point tables.
- E. Hydronic Remote Differential Pressure Transmitters: Bell & Gossett ST Series; Setra, or approved equal. Transmitter shall provide an isolated linear 4-20 mA dc output. The unit shall be accurate to $\pm 0.07\%$ of full span, and shall withstand over ranges up to a static pressure of 2300 psi with negligible change in output. It shall have stainless steel wetted parts with 1/4" NPT process connection. Unit shall be protected against radio frequency interference and shall have a water tight (NEMA Type 6/6P) electrical enclosure with 1/2" NPT conduit connection.

2.4 ELECTRICAL POWER AND DISTRIBUTION

- A. Transformers: Transformers shall conform to UL 506. For control power other than terminal level equipment, provide a fuse or circuit breaker on the secondary side of each transformer.
- B. Surge and Transient Protection
 - 1. Provide each digital controller with surge and transient power protection. Surge and transient protection shall consist of the following devices, installed externally to the controllers.
 - 2. Power Line Surge Protection: Provide surge suppressors on the incoming power at each controller or grouped terminal controllers. Surge suppressors shall be rated in accordance with UL 1449, have a fault indicating light, and conform to the following:
 - a. The device shall be a transient voltage surge suppressor, hard-wire type individual equipment protector for 120 VAC/1 phase/2 wire plus ground.
 - b. The device shall react within 5 nanoseconds and automatically reset.
 - c. The voltage protection threshold, line to neutral, shall be no more than 211 volts.
 - d. The device shall have an independent secondary stage equal to or greater than the primary stage joule rating.
 - e. The primary suppression system components shall be pure silicon avalanche diodes.
 - f. The secondary suppression system components shall be silicon avalanche diodes or metal oxide varistors.
 - g. The device shall have an indication light to indicate the protection components are functioning.
 - h. All system functions of the transient suppression system shall be individually fused and not short circuit the AC power line at any time.
 - i. The device shall have an EMI/RFI noise filter with a minimum attenuation of 13 dB at 10 kHz to 300 MHz.

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- j. The device shall comply with IEEE C62.41.1 and IEEE C62.41.2, Class "B" requirements and be tested according to IEEE C62.45.
 - k. The device shall be capable of operating between -20 degrees F and 122 degrees F.
3. Telephone and Communication Line Surge Protection: Provide surge and transient protection for DDC controllers and DDC network related devices connected to phone and network communication lines. The device shall provide continuous, non-interrupting protection, and shall automatically reset after safely eliminating transient surges. The protection shall react within 5 nanoseconds using only solid-state silicon avalanche technology. The device shall be installed at the distance recommended by its manufacturer.
4. Controller Input/Output Protection: Provide controller inputs and outputs with surge protection via optical isolation, metal oxide varistors (MOV), or silicon avalanche devices. Fuses are not permitted for surge protection.
- C. Wiring: Provide complete electrical wiring for the DDC System, coordinate line of demarcation with Division 26. Unless indicated otherwise, provide all normally visible or otherwise exposed wiring in conduit. Where conduit is required, control circuit wiring shall not run in the same conduit as power wiring over 100 volts. Circuits operating at more than 100 volts shall be in accordance with Division 26. Run all circuits over 100 volts in conduit, metallic tubing, covered metal raceways, or armored cable. Use plenum-rated cable for circuits under 100 volts in enclosed spaces. Examples of these spaces include HVAC plenums, within walls, attics, or above suspended ceilings.
- D. Power Wiring: The following requirements are for field-installed wiring:
- 1. Wiring for 24 V circuits shall be insulated copper 18 AWG minimum and rated for 300 VAC service.
 - 2. Wiring for 120 V circuits shall be insulated copper 14 AWG minimum and rated for 600 VAC service.
- E. Analog Signal Wiring: Field-installed analog signal wiring shall be 18 AWG single or multiple twisted pair. Each cable shall be 100 percent shielded and have a 20 AWG drain wire. Each wire shall have insulation rated for 300 VAC service. Cables shall have an overall aluminum-polyester or tinned-copper cable-shield tape.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the architect/engineer for resolution before rough-in work is started.
- B. The contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the engineer for resolution before

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rough-in work is started. Verify that duct-, pipe-, and equipment-mounted devices and wiring are installed before proceeding with installation.

- C. The contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate—or if any discrepancies occur between the plans and the contractor's work of others—the contractor shall report these discrepancies to the engineer and shall obtain written instructions for any changes necessary to accommodate the contractor's work with the work of others. Any changes in the work covered by this specification made necessary by the failure or neglect of the contractor to report such discrepancies shall be made by—and the expense of—this contractor.

3.2 INSTALLATION

- A. Provide software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation. Connect and configure equipment and software to achieve sequence of operation specified.
- B. Provide all components in accordance with the manufacturer's recommendations. Perform the installation under the supervision of competent technicians regularly employed in the installation of DDC systems.
- C. Provide equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.
- D. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices. Contractor shall continually monitor the field installation for code compliance and quality of workmanship. Contractor shall have work inspected by local and/or state authorities having jurisdiction over the work.
- F. Provide hydronic instrument wells, valves, and other accessories according to Section 23 21 16 "Hydronic Piping Specialties." Provide thermowells for sensors measuring piping, tank, or pressure vessel temperatures. Locate wells to sense continuous flow conditions. Do not install wells using extension couplings. Where piping diameters are smaller than the length of the wells, provide wells in piping at elbows to sense flow across entire area of well. Wells shall not restrict flow area to less than 70 percent of pipe area. Increase piping size as required to avoid restriction. Provide thermal conductivity material within the well to fully coat the inserted sensor.

3.3 WIRING

- A. All control and interlock wiring shall comply with national and local electrical codes, and Division 26 of this specification. Where the requirements of this section differ from Division 26, the requirements of this section shall take precedence.

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- B. NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway according to NEC and Division 26 requirements. Low-voltage wiring shall meet NEC Class 2 requirements. Low-voltage power circuits shall be sub-fused when required to meet Class 2 current limit.
- C. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in raceway may be used provided that cables are UL listed for the intended application.
- D. Do not install Class 2 wiring in raceways containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).
- E. Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or perpendicular to it and neatly tied at 10 ft intervals.
- F. Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.
- G. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.
- H. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- I. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the contractor shall provide step-down transformers.
- J. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.
- K. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.
- L. Size of raceway and size and type of wire type shall be the responsibility of the contractor in keeping with the manufacturer's recommendations and NEC requirements, except as noted elsewhere.
- M. Include one pull string in each raceway 2.5 cm (1 in.) or larger.
- N. Use color-coded conductors throughout with conductors of different colors.
- O. Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.
- P. Conceal all raceways except within mechanical, electrical, or service rooms.

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- Q. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.
- R. Adhere to this specification's Division 26 requirements where raceway crosses building expansion joints.
- S. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of vertical raceways.
- T. The contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.
- U. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 1 m (3 ft) in length and shall be supported at each end. Flexible metal raceway less than ½ in. electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal raceways shall be used.
- V. Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (according to code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

3.4 COMMUNICATION WIRING

- A. The contractor shall adhere to the items listed in the "Wiring" article in Part 3 of the specification. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling
- B. Do not install communication wiring in raceways and enclosures containing Class 1 or other Class 2 wiring.
- C. Maximum pulling, tension, and bend radius for the cable installation, as specified by the cable manufacturer, shall not be exceeded during installation.
- D. Contractor shall verify the integrity of the entire network following cable installation. Use appropriate test measures for each particular cable.
- E. When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lightning arrestor shall be installed according to manufacturer's instructions.
- F. All runs of communication wiring shall be unspliced length when that length is commercially available.
- G. All communication wiring shall be labeled to indicate origination and destination data.

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- H. Grounding of coaxial cable shall be in accordance with NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."
- I. BACnet MS/TP communications wiring shall be installed in accordance with ASHRAE/ANSI Standard 135. This includes but is not limited to:
 - 1. The network shall use shielded, twisted-pair cable with characteristic impedance between 100 and 120 ohms. Distributed capacitance between conductors shall be less than 100 pF per meter (30 pF per foot.)
 - 2. The maximum length of an MS/TP segment is 1200 meters (4000 ft) with AWG 18 cable. The use of greater distances and/or different wire gauges shall comply with the electrical specifications of EIA-485.
 - 3. The maximum number of nodes per segment shall be 32, as specified in the EIA 485 standard. Additional nodes may be accommodated by the use of repeaters.
 - 4. An MS/TP EIA-485 network shall have no T connections.
- J. Fiber Optic Cable: Maximum pulling tensions as specified by the cable manufacturer shall not be exceeded during installation. Post-installation residual cable tension shall be within cable manufacturer's specifications. All cabling and associated components shall be installed in accordance with manufacturers' instructions. Minimum cable and unjacketed fiber bend radii, as specified by cable manufacturer, shall be maintained.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 - 2. Test and adjust controls and safeties.
 - 3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 - 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
 - 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 - 6. Test each system for compliance with sequence of operation.
 - 7. Test software and hardware interlocks.
- B. DDC Verification:
 - 1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
 - 2. Check instruments for proper location and accessibility.
 - 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
 - 4. Check instrument tubing for proper fittings, slope, material, and support.

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5. Check installation of air supply for each instrument.
 6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
 7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
 8. Check temperature instruments and material and length of sensing elements.
 9. Check control valves. Verify that they are in correct direction.
 10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
 11. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.
- C. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.6 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:
 - a. Check analog inputs at 0, 50, and 100 percent of span.
 - b. Check analog outputs using milliamper meter at 0, 50, and 100 percent output.
 - c. Check digital inputs using jumper wire.
 - d. Check digital outputs using ohmmeter to test for contact making or breaking.
 - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
5. Flow:
 - a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
 - b. Manually operate flow switches to verify that they make or break contact.

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6. Pressure:
 - a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
 - b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
 7. Temperature:
 - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
 - b. Calibrate temperature switches to make or break contacts.
 8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
 9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
 10. Provide diagnostic and test instruments for calibration and adjustment of system.
 11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.
- B. Adjust initial temperature and humidity set points.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Section 01 79 00 "Demonstration and Training."
- B. Provide a qualified instructor (or instructors) with five years minimum field experience with the installation and programming of similar BACnet DDC systems. Orient training to the specific systems installed. Coordinate training times with the Owner. Training shall take place at the job site.
- C. This training shall last 8 hours and shall be conducted at the DDC system workstation, at a notebook computer connected to the DDC system in the field, and at other site locations as necessary. Upon completion of the Training, each trainee should fully understand the project's DDC system operation. The training session shall include the following:
- D. Provide basic control system fundamentals training.
 1. This project's list of control system components
 2. This project's list of points and objects

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3. This project's device and network communication architecture
4. This project's sequences of control, and:
5. Alarm capabilities
6. Trending capabilities
7. Troubleshooting communication errors
8. Troubleshooting hardware errors

E. Provide additional project-specific training:

1. A walk-through tour of the mechanical system and the installed DDC components (controllers, valves, dampers, surge protection, switches, thermostats, sensors, etc.)
2. A discussion of the components and functions at each DDC panel
3. Logging-in and navigating at each operator interface type
4. Using each operator interface to find, read, and write to specific controllers and objects
5. Modifying and downloading control program changes
6. Modifying setpoints
7. Creating, editing, and viewing trends
8. Creating, editing, and viewing alarms
9. Creating, editing, and viewing operating schedules and schedule objects
10. Backing-up and restoring programming and data bases
11. Modifying graphic text, backgrounds, dynamic data displays, and links to other graphics
12. Creating new graphics and adding new dynamic data displays and links

13. Alarm and Event management
14. Adding and removing network devices

3.8 TEST AND BALANCE SUPPORT

- A. The controls contractor shall coordinate with and provide on-site support to the test and balance (TAB) personnel This support shall include:
1. On-site operation and manipulation of control systems during the testing and balancing.
 2. Control setpoint adjustments for balancing all relevant mechanical systems.
 3. Tuning control loops with setpoints and adjustments determined by TAB personnel.

3.9 CONTROLS SYSTEM OPERATORS MANUALS

- A. Provide three electronic and printed copies of a Controls System Operators Manual. The manual shall be specific to the project, written to actual project conditions, and provide a complete and concise depiction of the installed work. Provide information in detail to clearly explain all operation requirements for the control system.
- B. Provide with each manual: CDs of the project's control system drawings, control programs, data bases, graphics, and all items listed below. Include gateway back-up data and configuration tools where applicable. Provide CDs in jewel case with printed and dated project-specific labels on both the CD and the case. For text and drawings, use Adobe Acrobat or MS Office file types.

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When approved by the Owner, AutoCAD and Visio files are allowed. Give files descriptive English names and organize in folders.

- C. Provide printed manuals in sturdy 3-ring binders with a title sheet on the outside of each binder indicating the project title, project location, contract number, and the controls contractor name, address, and telephone number. Each binder shall include a table of contents and tabbed dividers, with all material neatly organized. Manuals shall include the following:
1. A copy of the as-built control system (shop) drawings set, with all items specified under the paragraph "Submittals." Indicate all field changes and modifications.
 2. A copy of the project's mechanical design drawings, including any official modifications and revisions.
 3. A copy of the project's approved Product Data submittals provided under the paragraph "Submittals."
 4. A copy of the project's approved Performance Verification Testing Plan and Report.
 5. A copy of the project's approved final TAB Report.
 6. Printouts of all control system programs, including controller setup pages if used. Include plain-English narratives of application programs, flowcharts, and source code.
 7. Printouts of all physical input and output object properties, including tuning values, alarm limits, calibration factors, and set points.
 8. A table entitled "AC Power Table" listing the electrical power source for each controller. Include the building electrical panel number, panel location, and circuit breaker number.
 9. The DDC manufacturer's hardware and software manuals in both print and CD format with printed project-specific labels. Include installation and technical manuals for all controller hardware, operator manuals for all controllers, programming manuals for all controllers, operator manuals for all workstation software, installation and technical manuals for the workstation and notebook, and programming manuals for the workstation and notebook software.
 10. A list of qualified control system service organizations for the work provided under this contract. Include their addresses and telephone numbers.
 11. A written statement entitled "Software Upgrades" stating software and firmware patches and updates will be provided upon request at no additional cost to the Owner for a minimum of two years from contract acceptance. Include a table of all DDC system software and firmware provided under this contract, listing the original release dates, version numbers, part numbers, and serial numbers.

3.10 CLEANING

- A. The contractor shall clean up all debris resulting from his/her activities daily. The contractor shall remove all cartons, containers, crates, etc., under his/her control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.
- B. At the completion of work in any area, the contractor shall clean all work, equipment, etc., keeping it free from dust, dirt, and debris, etc.
- C. At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be required to match the

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adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

END OF SECTION 23 09 00

SECTION 23 09 01 - VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes solid-state, PWM, VFDs for speed control of three-phase, squirrel-cage induction motors.
- B. Related Sections include the following:
 - 1. Division 23 Section "Common Work Results for Mechanical"
 - 2. Division 26

1.3 SUBMITTALS

- A. Shop Drawings shall include: Wiring diagrams, electrical schematics, front and side views of enclosures, overall dimensions, conduit entrance locations and requirements, nameplate legends, physical layout and enclosure details.
- B. Product Data: Provide data sheets showing; voltage, ratings of customer use switching and over-current protective devices, short circuit ratings, and weights.
- C. Manufacturer's Installation Instructions and Technical Manuals: Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of adjustable speed drive. Document the sequence of operation, cautions and warnings, trouble shooting procedures, spare parts lists and programming guidance

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. Source Limitations: Obtain VFDs of a single type through one source from a single manufacturer.

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- C. Electrical Components, Devices, and Accessories: Comply with NFPA 70. 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. Store VFDs indoors in clean, dry space with uniform temperature to prevent condensation. Protect VFDs from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.5 COORDINATION

- A. Coordinate power wiring to VFD with Division 26.
- B. Coordinate layout and installation of VFDs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- C. Coordinate features of VFDs, installed units, and accessory devices with pilot devices and control circuits to which they connect.
- D. Coordinate features, accessories, and functions of each VFD and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Honeywell SmartVFD
 - 2. Eaton H-Max Series
 - 3. ABB ACH550
 - 4. Cerus Industrial P Series
 - 5. Danfoss VLT HVAC Drive
 - 6. GE AF-600 FP
 - 7. Allen-Bradley PowerFlex 700
 - 8. Toshiba VF-FS1
 - 9. Yaskawa E7 Series
 - 10. Siemens Micromaster

2.2 VARIABLE FREQUENCY DRIVES

- A. The VFDs shall be rated for voltage as scheduled. The VFD shall provide microprocessor based control for three-phase induction motors. The controller's full load output current rating shall be

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based on Variable Torque application at 40° C ambient and 1-16 kHz switching frequency below 50 HP and 1-10 kHz 50 HP and above to reduce motor noise and avoid increased motor losses.

- B. The VFD shall be of the Pulse Width Modulated (PWM) design converting the utility input voltage and frequency to a variable voltage and frequency output via a two-step operation. Adjustable Current Source VFD are not accepted. Insulated Gate Bipolar Transistors (IGBT's) shall be used in the inverter section. Bipolar Junction Transistors, GTO's or SCR's are not accepted. The VFD shall run at the above listed switching frequencies.
- C. The VFD shall have an efficiency at full load and speed that exceeds 95% for VFD below 15 HP and 97% for drives 15 HP and above. The efficiency shall exceed 90% at 50% speed and load.
- D. The VFD shall maintain a minimum line side displacement power factor of 0.96, regardless of speed and load. The VFD shall have a one (1) minute overload current rating of 110% for variable torque applications.
- E. The VFD shall be capable of operating any NEMA design B squirrel cage induction motor, regardless of manufacturer, with a horsepower and current rating within the capacity of the VFD.
- F. The VFD shall have an integral EMI/RFI filter as standard.
- G. The VFD shall limit harmonic distortion reflected onto the utility system to voltage and current levels as defined by IEEE 519-1992 for general systems applications, by utilizing the standard 3% nominal impedance integral AC three-phase line reactor. DC link chokes are not accepted.
- H. Any harmonic calculations shall be done based on the kVA capacity, X/R ratio and the impedance of the utility transformer feeding the installation, as noted on the drawings, and the total system load. The calculations shall be made with the point of common coupling (PCC) being the point where the utility feeds multiple customers.
- I. Total harmonic distortion shall be calculated under worst case conditions in accordance with the procedure outlined in IEEE 519-1992. Copies of these calculations are to be made available upon request. The contractor shall provide any needed information to the VFD supplier three (3) weeks prior to requiring harmonic calculations.
- J. The system containing the VFD shall comply with the 5% level of total harmonic distortion of line voltage and the line current limits as defined in IEEE 519-1992. If the system cannot meet the harmonic levels with the VFD provided with the standard input line reactor or optional input isolation transformer, the VFD manufacturer shall supply an eighteen pulse, multiple bridge rectifier, AC to DC conversion section with phase shifting transformer for all drives above 75 HP. This eighteen pulse rectifier converter shall result in a multiple pulse current waveform that will more nearly approximate a true sine wave to reduce voltage harmonic content on the utility line. The phase shifting transformer shall be of a single winding type to optimize its KVA rating and harmonic cancellation capability. Harmonic filters are not accepted above 75 HP.

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- K. The VFD shall be able to start into a spinning motor. The VFD shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the VFD shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor to the preset speed.
- L. Standard operating conditions shall be:
1. Incoming Power: Three-phase, VAC as scheduled (+10% to -15%) and 50/60 Hz (+/-5 Hz) power to a fixed potential DC bus level.
 2. Frequency stability of +/-0.05% for 24 hours with voltage regulation of +/-1% of maximum rated output voltage.
 3. Speed regulation of +/- 0.5% of base speed.
 4. Load inertia dependant carryover (ride-through) during utility loss.
 5. Insensitive to input line rotation.
 6. Humidity: 0 to 95% (non-condensing and non-corrosive).
 7. Altitude: 0 to 3,300 feet (1000 meters) above sea level.
 8. Ambient Temperature: -10 to 40 °C (VT).
 9. Storage Temperature: -40 to 70 °C.
- M. Control Functions
1. Frequently accessed VFD programmable parameters shall be adjustable from a digital operator keypad located on the front of the VFD. The VFD shall have a 3 line alphanumeric programmable display with status indicators. Keypads must use plain English words for parameters, status, and diagnostic messages. Keypads that are difficult to read or understand are not accepted, and particularly those that use alphanumeric code and tables. Keypads shall be adjustable for contrast with large characters easily visible in normal ambient light.
 2. The keypad shall include a Hand-Off-Auto membrane selection and an Inverter/Bypass membrane selection. When in “Hand” the VFD will be started and the speed will be controlled from the up/down arrows. When in “Off”, the VFD will be stopped. In “Auto”, the VFD will start via an external contact closure or a communication network and the VFD speed will be controlled via an external speed reference.
 3. The keypad shall have copy / paste capability.
 4. Upon initial power up of the VFD, the keypad shall display a start up guide that will sequence all the necessary parameter adjustments for general start up.
 5. Standard advanced programming and trouble-shooting functions shall be available by using a personal computer’s RS-232 port and Windows™ based software. In addition the software shall permit control and monitoring via the VFD’ RS232 port. The manufacturer shall supply a diskette with the required software. An easily understood instruction manual and software help screens shall also be provided. The computer software shall be used for modifying the drive setup and reviewing diagnostic and trend information as outlined in this section through Section 18.
 6. The operator shall be able to scroll through the keypad menu to choose between the following:
 - a. Parameter Menu
 - b. Keypad Control

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- c. System Menu
 - d. Expander Boards
 - e. Monitoring Menu
 - f. Operate Menu
7. The following setups and adjustments, at a minimum, are to be available:
- a. Start command from keypad, remote or communications port
 - b. Speed command from keypad, remote or communications port
 - c. Motor direction selection
 - d. Maximum and minimum speed limits
 - e. Acceleration and deceleration times, two settable ranges
 - f. Critical (skip) frequency avoidance
 - g. Torque limit
 - h. Multiple attempt restart function
 - i. Multiple preset speeds adjustment
 - j. Catch a spinning motor start or normal start selection
 - k. Programmable analog output
- N. The VFD shall have the following system interfaces:
- 1. Inputs – A minimum of six (6) programmable digital inputs, two (2) analog inputs and serial communications interface shall be provided with the following available as a minimum:
 - a. Remote manual/auto
 - b. Remote start/stop
 - c. Remote forward/reverse
 - d. Remote preset speeds
 - e. Remote external trip
 - f. Remote fault reset
 - g. Process control speed reference interface, 4-20mA DC
 - h. Potentiometer or process control speed reference interface, 0 -10VDC
 - i. RS-232 programming and operation interface port
 - 2. Outputs – A minimum of two (2) discrete programmable digital outputs, one (1) programmable open collector output, and one (1) programmable analog output shall be provided, with the following available at minimum.
 - a. Programmable relay outputs with one (1) set of Form C contacts for each, selectable with the following available at minimum:
 - 1) Fault
 - 2) Run
 - 3) Ready
 - 4) Reversing
 - 5) Jogging
 - 6) At speed

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- 7) In torque limit
 - 8) Motor rotation direction opposite of commanded
 - 9) Over-temperature
 - b. Programmable open collector output with available 24 Vdc power supply and selectable with the following available at minimum:
 - 1) Fault
 - 2) Run
 - 3) Ready
 - 4) Reversing
 - 5) Jogging
 - 6) At speed
 - 7) In torque limit
 - 8) Motor rotation direction opposite of commanded
 - 9) Overtemperature
 - c. Programmable analog output signal, selectable with the following available at minimum:
 - 1) Output frequency
 - 2) Frequency reference
 - 3) Motor speed
 - 4) Output current
 - 5) Motor torque
 - 6) Motor power
 - 7) Motor voltage
 - 8) DC link voltage
 - 9) PID controller reference value
 - 10) PID controller actual value 1
 - 11) PID controller actual value 2
 - 12) PID controller error value
 - 13) PID controller output
 3. Capability of two additional expandable I/O interface cards. Upon installation, software shall automatically identify the interface card and activate the appropriate parameters. This should be done without adding any new software.
- O. Monitoring and Displays
1. The VFD display shall be a LCD type capable of displaying three (3) lines of text and the following thirteen (13) status indicators:
 - a. Run
 - b. Forward
 - c. Reverse
 - d. Stop
 - e. Ready

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- f. Alarm
 - g. Fault
 - h. Input/Output (I/O) Terminal
 - i. Keypad
 - j. Bus/communication
 - k. Hand
 - l. Auto
 - m. Off
2. The VFD keypad shall be capable of displaying the following monitoring functions at a minimum:
- a. Motor Speed (RPM and %)
 - b. Frequency reference
 - c. Output frequency
 - d. Motor current
 - e. Motor torque
 - f. Motor power
 - g. Motor voltage
 - h. DC-link voltage
 - i. Heat sink temperature
 - j. Motor run time (resettable)
 - k. Total operating days counter
 - l. Operating hours (resettable)
 - m. Total megawatt hours
 - n. Megawatt hours (resettable)
 - o. Voltage level of analog input
 - p. Current level of analog input
 - q. Digital inputs status
 - r. Digital and relay outputs status
 - s. Motor temperature rise
 - t. PID references

P. Protective Functions

1. The VFD shall include the following protective features at minimum:
- a. Over-current
 - b. Over-voltage
 - c. System fault
 - d. Under-voltage
 - e. Input line supervision
 - f. Output phase supervision
 - g. Under-temperature
 - h. Over-temperature
 - i. Motor stalled
 - j. Motor over temperature
 - k. Motor under-load

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- l. Logic voltage failure
 - m. Microprocessor failure
 - n. Brake chopper supervision
 - o. DC Injection braking
2. The VFD shall provide ground fault protection during power-up, starting, and running. VFD with no ground fault protection during running are not accepted.

Q. Diagnostic Features

1. Active Faults
2. The last 10 faults shall be recorded and stored in sequential order
3. Fault code and description of fault shall be displayed on the keypad.
4. Fault or alarm LED shall blink
5. Display drive data at time of fault
6. In the event several faults occur simultaneously, the sequence of active faults shall be viewable.
7. During a fault, the drive must be able to identify the following:
 - a. Drive Speed
 - b. Running hours
 - c. Running Days
 - d. Amps during fault
 - e. Motor Power
 - f. Motor Torque
 - g. DC bus Voltage
 - h. Drive Temperature
8. Fault History
 - a. The last 30 faults shall be recorded and stored in sequential order.
 - b. Display drive data at time of fault

R. Additional features included in the VFD:

1. The following indicating lights shall be provided on the keypad.
 - a. Drive Ready
 - b. Drive Run
 - c. Drive Fault
2. The current withstand rating of the drive shall be 100,000 AIC. The rating of the complete drive assembly shall be UL tested and listed at 65kAIC.
3. Communication card for interface with BACnet control system.
4. The VFD shall have a cooling fan that is field replaceable using non-screw accessibility.

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- S. Enclosure
 - 1. The VFD shall be designed in a NEMA Type [1- general purpose] [12-drip tight] [3R-rain proof] enclosure. Packaging of the drive shall be designed and manufactured by the manufacturer of the drive for quality assurance.
 - 2. The VFD shall have complete front accessibility with easily removable assemblies.
 - 3. Cable entry shall be bottom entry.

- T. Disconnect Switch: allows a convenient means of disconnecting the drive from the line; operating mechanism can be padlocked in the OFF position; factory-mounted in the enclosure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFDs for compliance with requirements, installation tolerances, and other conditions affecting performance. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFD installation.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Select features of each VFD to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, controller, and load.

- B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

- A. Anchor each VFD assembly to steel-channel sills or unitstrut arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with mounting surface.

- B. Comply with mounting and anchoring requirements specified in Division 26.

- C. Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26.

3.4 IDENTIFICATION

- A. Identify VFDs, components, and control wiring according with labeling that indicates the controlled device.

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3.5 CONTROL WIRING INSTALLATION

- A. Install wiring between VFDs and remote devices according to Division 26.
- B. Bundle, train, and support wiring in enclosures.
- C. Connect hand-off-automatic switch and other automatic-control devices where applicable.
 - 1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
 - 2. Connect selector switches with control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

- A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding."

3.7 FIELD QUALITY CONTROL

- A. Provide the services of a qualified manufacturer's employed Field Service Engineer or authorized service representative to assist the Contractor in installation and start-up of the equipment specified under this section. Field Service personnel shall be factory trained with periodic updates and have experience with the same model of VFD's on the job site. Sales representatives will not be accepted to perform this work. The manufacturer's service representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, installation as specified in manufacturer's installation instructions, wiring, application dependant adjustments, and verification of proper VFD operation.
- B. The following minimum work shall be performed by the Contractor under the technical direction of the manufacturer's service representative.
 - 1. Inspection and final adjustments.
 - 2. Operational and functional checks of VFDs and spare parts.
 - 3. The contractor shall certify that he has read the drive manufacturer's installation instructions and has installed the VFD in accordance with those instructions.
- C. The Contractor shall provide three (3) copies of the manufacturer's field start-up report before final payment is made. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS. Certify compliance with test parameters.

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2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.8 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.9 DEMONSTRATION

- A. The Contractor shall provide a training session for one normal workday with a maximum of one trip. Training and instruction time shall be in addition to that required for start-up service. The training shall be conducted by the manufacturer's qualified representative. The training program shall consist of the following:
 1. Instructions on the proper operation of the equipment.
 2. Instructions on the proper maintenance of the equipment.

END OF SECTION 23 09 01

SECTION 23 09 93 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 23 Section “Common Work Results for Mechanical”
 - 2. Section 23 09 00 – Instrumentation and Control for HVAC for control equipment and devices and submittal requirements.
 - 3. Division 23 Sections – Equipment with built in DDC controllers
 - 4. Division 23 Section “Testing, Adjusting, and Balancing”
 - 5. Division 26

1.2 GENERAL

- A. This Section includes control sequences for HVAC systems, subsystems, and equipment. Provide control devices, control software and control wiring as required for automatic operation of each sequence specified. The system is BAS controlled using electric actuation.
 - 1. Provide automatic control for system operation as described herein, although word “automatic” or “automatically”, is not used.
 - 2. Manual operation is limited only where specifically described; however, provide manual override for each automatic operation.
 - 3. Where manual start-up is called for, also provide scheduled automatic start-stop capabilities.
- B. These sequences are intended to be performance based. Implementations that provide the same functional result using different underlying detailed logic will be acceptable.
- C. Unless otherwise indicated, control loops shall be enabled and disabled based on the status of the system being controlled to prevent windup. When a control loop is enabled or re-enabled, it and all its constituents (such as the proportional and integral terms) shall be set initially to a Neutral value. A control loop in Neutral shall correspond to a condition that applies the minimum control effect, i.e., valves/dampers closed, VFDs at minimum speed, etc.
- D. The term “proven” (i.e., “proven on”/ “proven off”) shall mean that the equipment’s DI status point (where provided, e.g. current switch, DP switch, or VFD status) matches the state set by the equipment’s DO command point.

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- E. The term “software point” shall mean an analog variable, and “software switch” shall mean a digital (binary) variable, that are not associated with real I/O points. They shall be read/write capable (e.g., BACnet analog variable and binary variable).
- F. Functions called for in sequence of operations are minimum requirements and not to limit additional BAS system capabilities. Determine, through operation of the system, proportional bands, interval time, integral periods, adjustment rates, and any other input information required to provide stable operation of the control programs.
- G. To avoid abrupt changes in equipment operation, the output of every control loop shall be capable of being limited by a user adjustable maximum rate of change, with a default of 25% per minute.
- H. Setpoints, timers, deadbands, PID gains, etc., listed in sequences shall be adjustable by the user with appropriate access level whether indicated as adjustable in sequences or not. Software points shall be used for these variables. Fixed scalar numbers shall not be embedded in programs except for physical constants and conversion factors.
- I. Values for all points, including real (hardware) points used in control sequences shall be capable of being overridden by the user with appropriate access level (e.g., for testing and commissioning). If hardware design prevents this for hardware points, they shall be equated to a software point and the software point shall be used in all sequences.
- J. For each item of equipment, provide following functions which are not specifically mentioned in each Sequence of Operation:
 - 1. Start-Stop, manual, and scheduled
 - 2. On-Off status of each piece of equipment
 - 3. Run-time
 - 4. Alarm
- K. Provide Sequenced starting of HVAC equipment, whether or not specifically mentioned in each Sequence of Operation: At initial start-up; for automatic starting on emergency power, or after power blackout.
- L. Setback Controls:
 - 1. Heating systems shall be equipped with controls configured to automatically restart and temporarily operate the system as required to maintain zone temperatures above an adjustable heating setpoint at least 10°F below the occupied heating setpoint.
 - 2. Cooling systems shall be equipped with controls configured to automatically restart and temporarily operate the mechanical cooling system as required to maintain zone temperatures below an adjustable cooling setpoint at least 5°F above the occupied cooling setpoint or to prevent high space humidity levels.
 - 3. Optimum Start Controls. Individual heating and cooling systems with setback controls shall have optimum start controls. The control algorithm shall, as a minimum, be a function of the difference between space temperature and occupied setpoint, the outdoor temperature, and the amount of time prior to scheduled occupancy.

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4. Radiant heating systems configured with a setback heating setpoint at least 4°F below the occupied heating setpoint. These systems shall incorporate floor temperature into the optimum start algorithm.
- M. All setpoints shall be monitored and adjustable. Setpoints listed herein are approximate. It is the responsibility of the BAS contractor to calibrate the system and all setpoints to actual working conditions once the system is on line.
- N. Variable Frequency Drives
1. To avoid operator confusion, the speed command point (and speed feedback point, if used) for VFDs should be configured so that a speed of 0% corresponds to 0 Hz and 100% corresponds to maximum speed set in the VFD, not necessarily 60 Hz. The maximum speed may be limited below 60 Hz to protect equipment or it may be above 60 Hz for direct drive equipment. Many times drives are configured such that a 0% speed signal corresponds to the minimum speed programmed into the VFD, but that causes the speed AO value and the actual speed to deviate from one another.
 2. For each piece of equipment, the minimum speed shall be stored in a single software point. This value shall be written to the VFD's minimum speed setpoint via the drive's network interface; in the case of a hard-wired VFD interface, the minimum speed shall be the lowest speed command sent to the drive by the BAS.
 3. Current VFD status and operating conditions shall be monitored through its communications interface port. The interface shall monitor the following software points: Motor RPM, motor amps, motor runtime, VFD status, "In fault condition", and "In bypass".
 4. System Dampers:
 - a. Damper control typically consists of a requirement to open a damper (such as an outdoor air damper, smoke damper, isolation damper, etc.) before the motor is to operate in any mode (drive or bypass). This means that a "start" or "run" command can come from the BAS, an operator at the VFD provides a local "start" command at the VFD keypad, or the command can come from the serial communication connection.
 - b. After a run command is received, but before the VFD actually runs the motor, the VFD shall close a relay contact to actuate the damper. When the damper is fully open, an end switch from the damper will close and then the VFD will be allowed to operate the motor. The damper end-switches shall be mounted such that they can be adjusted during start-up so the open indication is only provided when the damper is in the fully open position.
 - c. Ensure that the VFD has an input that when activated, will stop the motor in any VFD operating mode as well as bypass.
 - d. Where dampers operate in conjunction with fan operation, the damper open signal shall precede the fan start signal by 10-23 seconds. The damper close signal shall be delayed 10-23 seconds after the fan stop signal.

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O. Alarms

1. All alarms shall include a Time/Date Stamp using the standalone control module time and date.
2. Each alarm can be configured in terms of criticality (Critical/Not Critical), operator acknowledgement (Requires Acknowledgement/Does Not Require Acknowledgement), and conditions required for an alarm to clear automatically (Requires Acknowledgement of a Return to Normal/Does Not Require Acknowledgement of a Return to Normal).
3. An operator shall be able to sort alarms based on level, time/date, and current status.
4. Alarms should be reported with the following information:
 - a. Date and time of the alarm
 - b. Level of the alarm
 - c. Description of the alarm
 - d. Equipment tags for the units in alarm
 - e. Possible causes of the alarm, if provided by the fault detection routines
 - f. The source that serves the equipment in alarm
5. There shall be 5 levels of alarm
 - a. Level 1: Critical/life safety
 - b. Level 2: Significant equipment failure
 - c. Level 3: Non-critical equipment failure/operation
 - d. Level 4: Energy conservation monitor
 - e. Level 5: Maintenance indication, notification
 - f. 19.
6. Hierarchical Alarm Suppression: For each piece of equipment or space controlled by the BAS, define its relationship (if any) to other equipment in terms of “source,” “load,” or “system.”
 - a. Source: A component is a “source” if it provides resources to a downstream component, such as a chiller providing chilled water to an AHU.
 - b. Load: A component is a “load” if it receives resources from an upstream component, such as an AHU that receives chilled water from a chiller.
 - c. The same component may be both a load (receiving resources from an upstream source) and a source (providing resources to a downstream load).
 - d. System: A set of components is a “system” if they share a load in common (i.e., collectively act as a source to downstream equipment, such as a set of chillers in a lead/lag relationship serving air handlers).
 - 1) If a single component acts as a source for downstream loads (e.g., an AHU as a source for its VAV boxes), then that single source component shall be defined as a “system” of one element.
 - 2) For equipment with associated pumps (chillers, boilers, cooling towers):
 - a) If the pumps are in a one-to-one relationship with equipment they serve, the pumps shall be treated as part of the system to which they

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- are associated (i.e., they are not considered loads) since a pump failure will necessarily disable its associated equipment.
- b) If the pumps are headered to the equipment they serve, then the pumps may be treated as a system, which is a load relative to the upstream equipment (e.g., chillers) and a source relative to downstream equipment (e.g., air handlers).
 - e. For each system as defined above, there shall be a SystemOK flag, which is either true or false.
 - f. SystemOK shall be true when all of the following are true:
 - 1) The system is proven on.
 - 2) The system is achieving its temperature and/or pressure setpoint(s) for at least five minutes
 - 3) The system is ready and able to serve its load
 - g. SystemOK shall be false while the system is starting up (i.e., before reaching setpoint) or when enough of the system's components are unavailable (in alarm, disabled, or turned off) to disrupt the ability of the system to serve its load. This threshold shall be defined by the design engineer for each system.
 - 1) By default, Level 1 through Level 3 component alarms (indicating equipment failure) shall inhibit SystemOK. Level 4 and Level 5 component alarms (maintenance and energy efficiency alarms) shall not affect SystemOK.
 - 2) The operator shall have the ability to individually determine which component alarms may or may not inhibit SystemOK.
 - h. The BAS shall selectively suppress (i.e., fail to announce; alarms may still be logged to a database) alarms for load components if SystemOK is false for the source system that serves that load.
 - 1) If SystemOK is false for a cooling water system (i.e., chiller, cooling tower, or associated pump) then only high temperature alarms from the loads shall be suppressed.
 - 2) If SystemOK is false for a heating water system (i.e., boiler or associated pump) then only low temperature alarms from the loads shall be suppressed.
 - 3) If SystemOK is false for an airside system (air handler, fan coil, VAV box, etc.), then all alarms from the loads shall be suppressed.
 - i. This hierarchical suppression shall cascade through multiple levels of load-source relationship, such that alarms at downstream loads shall also be suppressed.
 - j. The following types of alarms will never be suppressed by this logic:
 - 1) Life/safety and Level 1 alarms
 - 2) Failure-to-start alarms (i.e., equipment is commanded on, but status point shows equipment to be off)

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- 3) Failure-to-stop/hand alarms (i.e., equipment is commanded off, but status point shows equipment to be on)
- P. Time-Based Suppression Block: This block is used to suppress reset requests and alarms after a change in setpoint. This includes automatic changes in setpoint, e.g., due to a change in occupancy sensor status, as well as changes made by occupants. This block shall calculate a time delay period after any change in setpoint based on the difference between the controlled variable (e.g., zone temperature) at the time of the change and the new setpoint. The default time delay period shall be:
1. For thermal zone temperature alarms: 10 minutes per °F of difference, but no longer than 120 minutes
 2. For thermal zone temperature cooling requests: 5 minutes per °F of difference, but no longer than 30 minutes
 3. For thermal zone heating requests: 5 minutes per °F of difference, but no longer than 30 minutes
- Q. Normal positions for controlled devices:
1. Unless noted, the following valves and dampers shall fail closed:
 - a. Outside air dampers
 - b. Relief air dampers
 - c. Exhaust air closure dampers
 - d. Steam valves at convertors
 - e. Cooling coil valves for coils located indoors shall close to the coil.
 - f. Domestic hot water heat source.
 - g. Humidifier valves.
 2. Unless noted, the following valves and dampers shall fail open:
 - a. Heating coils.
 - b. Cooling coil valves for coils located outdoors shall open to the coil.

1.3 ENERGY RECOVERY UNITS

A. Simple ERU

1. Occupied mode:
 - a. Normally closed outside air and exhaust dampers shall be open.
 - b. Supply and Exhaust fans operate continuously during occupied hours, subject to damper end switches.
 - c. Prove supply fan operation by current switch.
 - d. Prove exhaust fan operation by current switch.

2. Unoccupied mode:
 - a. OA and EA dampers 100% closed.
 - b. Fans off.

PART 2 - WATER SOURCE HEAT PUMP SYSTEM

2.1 HEAT PUMP LOOP WATER CONTROL

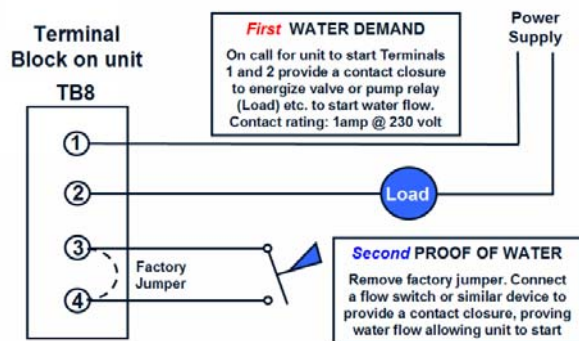
- A. Control of Loop water Circulating Pumps: Control for pumps shall remain as currently operating whereby existing pumps are energized during occupied cycle and modulate to maintain system differential pressure based upon water cooled condensing unit operation.
- B. Supplementary Heat Control: Existing control remains as currently operating whereby system modulates the three way bypass valve on drop in loop supply temperature to below nominal setpoint of 78 deg. On continued drop in temperature below setpoint, with three way valve in full bypass, hot water injection pump cycles to maintain a minimum loop-water temperature setpoint (78 deg adj).
- C. Provide a deadband between heat addition and heat rejection.
- D. Heat rejection Controls -closed circuit cooler (CCC):
 1. Existing heat rejection control shall be modified to incorporate the addition of a second closed circuit tower and variable speed driven fans on both the new and existing towers. The new and existing tower shall be operated together, with fan speeds modulating in unison for control as follows:
 - a. With loop flow proven, and the loop water temperature rises above setpoint, initiate first stage cooling which opens the CCC discharge dampers.
 - b. With discharge dampers proven open, and the continued rise in loop temperature above setpoint, start the CCC recirculating pumps.
 - c. When the loop water supply temperature reaches 86°F, start the CCC fans at low speed.
 - d. Modulate the CCC fan speeds to maintain nominal heat rejection loop supply temperature at 85 degrees (adj).
 - e. The sequence shall take place in reverse order upon a drop in loop temperature, minimum 3-minute run time for each step.
- E. Sump Heater
 1. Input Device: Sump temperature sensor.
 2. Output Device: Electric relay
 3. Action: Energize sump heater to maintain 40 minimum sump temperature.

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- F. Operator Workstation: Display the following data:
1. Outside temperature.
 2. Loop supply temperature, downstream of heat source.
 3. Loop supply temperature, downstream of closed circuit cooler.
 4. Loop supply water supply temperature set points.
 5. Loop return temperature to closed circuit coolers.
 6. Loop return water supply temperature set point.
 7. Operating status of heat injection pump.
 8. Position of CCC discharge dampers.
 9. Status of CCC pumps.
 10. Status of fan motors.
 11. Speed of fan motors.

2.2 WATER-COOLED VRF CONDENSING UNITS

- A. Coordinate with Section 23 81 29. Integrate and monitor all available BACnet points.
- B. Water-source modules contain a terminal block with dry contacts for proof of flow status via a field provided flow switch (BAS contractor shall provide), as well as a dry contact to energize the control circuit for the loop pump and motorized isolation valve.



- C. A normally open, on/off control condenser water shutoff valve shall be provided in the branch connection to each unit. The valve shall be open whenever the unit requires flow. The valve actuator shall be wired to the unit when there is a call for heating or cooling. The valve shall have an end switch to ensure valve is fully open prior to compressor operation.
- D. The on/off control valves shall be 2-way as indicated (See Water Cooled VRF Condensing Unit Schedule).
- E. Provide water supply temperature sensor to monitor the unit leaving temperature.

END OF SECTION 23 09 93

SECTION 23 21 13 – HYDRONIC HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 7 Section for materials and methods for sealing pipe penetrations.
 - 2. Division 23 Section "Common Work Results for Mechanical"
 - 3. Division 23 Section "Hangers and Supports" for pipe supports.
 - 4. Division 23 Section "Thermometers and Pressure Gages"
 - 5. Division 23 Section "Mechanical Identification" for labeling and identifying.
 - 6. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories.
 - 7. Division 23 controls section for temperature-control valves and sensors.

1.2 SUMMARY

- A. This Section includes piping and specialties for hydronic HVAC piping.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Piping
 - 2. Hydronic specialties
 - 3. Chemical treatment.
- B. Delegated-Design Submittal:
 - 1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
 - 2. Locations of pipe anchors and alignment guides and expansion joints and loops.

1.4 INFORMATIONAL SUBMITTALS

- A. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

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1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Qualify soldering processes, procedures, and solderers for copper and copper alloy pipe and tube in accordance with ASTM B 828.
- C. Qualify brazing processes for copper and copper alloy pipe and tube according to ANSI/AWS C3.4.
- D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
- E. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

1.7 COORDINATION

- A. Drawings show the general layout of piping and accessories but do not show all required fittings and offsets that may be necessary to connect piping to equipment and to coordinate with other trades. Fabricate piping based on field measurements. Provide all necessary fittings and offsets.
- B. Coordinate layout and installation of hydronic piping and suspension system components with other construction.
- C. Coordinate pipe sleeve installations and penetrations with other trades.
- D. Coordinate pipe fitting pressure classes with products specified in related Sections.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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1. Grooved Mechanical-Joint Fittings and Couplings:
 - a. Victaulic Company of America.
 - b. Anvil
 - c. Grinnell Corporation.

2. Balancing Valves:
 - a. Griswold Controls.
 - b. ITT Bell & Gossett
 - c. Taco, Inc.
 - d. Tour & Anderson
 - e. Flow Design, Inc.
 - f. Griswold Controls
 - g. Watts Industries Inc.
 - h. Caleffi
 - i. Nexus

3. Hydronic Pressure-Reducing Valves:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Conbraco Industries, Inc.
 - d. ITT Bell & Gossett
 - e. Spence Engineering Company, Inc.
 - f. Caleffi
 - g. Watts Industries, Inc.

4. Safety Valves:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Conbraco Industries, Inc.
 - d. ITT McDonnell & Miller.
 - e. Kunkle Valve Division.
 - f. Spence Engineering Company, Inc.
 - g. Caleffi
 - h. Watts Industries Inc.

5. Air Vents and Vacuum Breakers:
 - a. Armstrong International, Inc.
 - b. Barnes & Jones, Inc.
 - c. ITT Hoffman
 - d. Caleffi
 - e. Spirax Sarco, Inc.

2.2 PIPING MATERIALS

- A. General: Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

2.3 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. DWV Copper Tubing: ASTM B 306, Type DWV.
- C. Fitting Standard: Copper fittings shall conform to ASME B16.18, ASME B16.22 or ASME B16.26.
- D. Press Fitting: Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall have SC (Smart Connect) feature design (leakage path). In ProPress ½" to 4" dimensions the Smart Connect Feature assures leakage of liquids and/or gases from inside the system past the sealing element of an un-pressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.
- E. Wrought-Copper Unions: ASME B16.22.
- F. Solder Filler Metals: ASTM B 32, 95-5 tin antimony.
- G. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver).

2.4 PLASTIC PIPE AND FITTINGS

- A. CPVC Plastic Pipe: ASTM F 441/F 441M, Schedule 80.
- B. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 439 for Schedule 80 pipe.
- C. Solvent Cements for CPVC Piping: ASTM F 493.

2.5 STEEL PIPE AND FITTINGS

- A. Steel Pipe, NPS 2 and Smaller: ASTM A-53, Type S (seamless) or Type F (furnace-butt welded), Grade B, Schedule 40 and 80, black steel, plain ends.
- B. Steel Pipe, NPS 2-1/2 and larger: ASTM A-53, Type E (electric-resistance welded), Grade B, Schedule 40 and 80, black steel, plain ends.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.

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- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced.
- F. Wrought-Steel Fittings: ASTM A-234/A 234M, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings: Material Group: 1.1. End Connections: Butt-welding. Facings: Raised face.
- H. Grooved Mechanical-Joint Fittings and Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Victaulic or approved equal.
 - 2. Standard Grooved Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron, ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 234, Grade WPB forged steel fittings with grooves or shoulders constructed to accept Victaulic grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - 3. Standard Couplings: Ductile-iron housing and synthetic rubber gasket of central cavity pressure-responsive design (Grade “E” EPDM for water services –30°F to 230°F or Grade “EHP” EPDM for water services rated –30°F to 250°F); with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - a. Rigid Type: Housings shall be cast with offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with ASME B31.1 and B31.9; Victaulic Style 07 (Zero-Flex®) or Style 107 Quick-Vic® Installation-Ready design.
 - b. Flexible Type: Use in locations where vibration attenuation and stress relief are required. Victaulic Style 75 or 77.
 - c. Flange Adapters: Ductile iron housing, flat face, for use with grooved end pipe and fittings, for mating directly with ANSI Class 125, 150, and 300 flanges. Victaulic Style 741 or 743.
- I. Mechanically formed copper or steel tee connections are not acceptable.
- J. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ANSI B16.11 may be used for drain, vent and gage connections.
- K. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
- L. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.

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2.6 HYDRONIC VALVES

A. Gate Valves

1. Threaded Ends 2" and Smaller: Class 125, bronze body, union bonnet, rising-stem, solid wedge: Hammond IB617, Nibco T-124/134, Stockham B105, Milwaukee 1152 or equal.
2. Flanged Ends 2-1/2" and Larger: Class 125, iron body, bronze mounted, bolted bonnet, rising stem, OS&Y, solid wedge: Hammond IR1140, Nibco F617-0, Stockham G623, Milwaukee F2885 or equal.
3. Solder Ends 2" and Smaller: Class 125, bronze body, union bonnet, rising-stem, solid wedge: Hammond IB648, Nibco S134, Stockham B115, Milwaukee 1169 or equal.
4. Comply with the following standards: Cast Iron Valves: MSS SP – 70; Bronze Valves: MSS SP – 80.

B. Ball Valves

1. Threaded Ends 4" and Smaller: 150 psi WP and 600psi non-shock CWP, forged brass full-port or cast bronze two piece body, hard chrome plated forged brass ball, true adjustable packing nut ("O"-ring only type stem seal not acceptable), blow-out proof stem: Watts FBV-3C series/B6080 series, Hammond 8501, Nibco T-585-70, Milwaukee BA100, Apollo 70-Series, or approved equal.
2. Soldered Ends 3" and Smaller: 150 psi WP and 600psi non-shock CWP, full-port cast bronze or forged brass two piece body, hard chrome plated forged brass ball, true adjustable packing nut ("O"-ring only type stem seal not acceptable), blow-out proof stem: Watts FBVS-3C series/B6081 series, Hammond 8511, Nibco S-585-70, Milwaukee BA150, Apollo 70-Series, approved or equal.
3. Comply with MSS SP-110.

C. Butterfly Valves

1. Basis of Design: Center Line Series 200; Lug Type, cast iron, drilled and tapped lug body, ductile iron disc, 416SS shaft, bronze bushing, EPDM seat.
2. Valve bodies shall have extended necks to provide for 2-1/4" insulation as needed.
3. Comply with MSS SP-67.
4. Compatible with ANSI 125/150 flanges. Dead-end capacity to 200 psi.
5. Operators: 6" and smaller: handle with infinite adjustment; 8" and larger: gear w/balance-stop hand wheel. Valves located 7 feet or higher: provide gear/chain wheel.
6. Approved Manufacturers: Watts, Hammond, Nibco, Milwaukee, or approved equal.

D. Bronze Globe Valves, Class 125:

1. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem and Disc: Bronze.

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- f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron.

- E. Bronze Globe Valves, Class 150:
 - 1. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

- F. Iron Globe Valves, Class 125:
 - 1. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.
 - g. Operator: Handwheel or chainwheel.

- G. Iron Globe Valves, Class 250:
 - 1. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 500 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.
 - g. Operator: Handwheel or chainwheel.

- H. Wafer Check valves: Provide wafer style, butterfly type, spring actuated check valves designed to be installed with gaskets between two standard Class 125 flanges. Construct iron body valves with pressure containing parts of valves with materials conforming to ANSI/ASTM A 126, Grade B. Support hanger pin by removable side plug; Class 125, cast iron body, stainless steel trim, bronze disc, Buna-N seal., Watts BF/DBF series, Metraflex 700 Series, Nibco W920-W, Stockham WG970, Hammond 9253, Milwaukee 1400, or approved or equal.

- I. Swing check valves:
 - 1. Construct pressure containing parts of Valves as follows: Bronze Valves: 125 or 150 psi: ANSI/ASTM B 62; Iron Body Valves: ANSI/ASTM A-126, Grade B. Comply with the

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following standards for design, workmanship, material and testing: Bronze Valves: MSS SP – 80; Cast Iron Valves: MSS SP – 71.

2. Construct valves of pressure casting free of any impregnating materials. Construct disc and hanger as one piece. Support hanger pins by removable side plug.
 3. Threaded Ends 2" and Smaller: Class 125, bronze body, screwed cap, Teflon disc: Hammond IB904, Nibco T-413Y, Stockham B320T, Milwaukee 509 or approved equal.
 4. Soldered Ends 2" and Smaller: Class 125, bronze body, screwed cap, Teflon disc: Hammond IB912, Nibco S-413-Y, Stockham B310T, Milwaukee 511 or approved equal.
 5. Flanged Ends 2-1/2" and Larger: Class 125, iron body, bronze mounted, horizontal swing, cast-iron disc: Hammond IR1124, Nibco F918-B, Stockham G931, Milwaukee F2974 or approved equal.
- J. ASME Safety Relief Valves: Bell & Gossett A-434D, or equal; diaphragm-operated, bronze or brass body with brass and rubber, wetted, internal working parts; shall suit system pressure and heat capacity and shall comply with the ASME Boiler and Pressure Vessel Code, Section IV. The fluid shall not discharge into the spring chamber. The valve shall have a low blow-down differential. The valve seat and all moving parts exposed to the fluid shall be of non-ferrous material.

2.7 HOOKUPS AND BALANCING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
1. Nexus (Basis of Design)
 2. Flow Design
 3. Hays
 4. Griswold
 5. Victaulic
 6. Taco
 7. Bell & Gossett
- B. Minimum Requirements Per Coil Installation:
1. Automatic Flow Control Valve (AFCV) or Manual Flow Control Valve (MFCV) as indicated.
 2. Y-strainer.
 3. Temperature Control Valve (TCV) – see 230900.
 4. Union connections at coil and TCV.
 5. Air vent on return side.
 6. Blowdown/drain valve on supply side.
 7. Pressure/temperature test plugs across coil and TCV.
 8. Full port, union end ball valves or butterfly valve for shutoff.

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- C. Materials Of Construction (2½" and smaller, except as noted)
1. Brass or stainless steel metals.
 2. Teflon, EPDM or FKM seals.
- D. Installation
1. Installation shall conform to basic piping methods specifications.
 2. All components shall be isolated by shutoff valves.
 3. Flexible hoses shall be installed at coil connections as shown in the plans or at the option of the mechanical contractor.
 4. Union tailpieces may be used to reduce pipe sizes to match coil and TCV valve sizes.
 5. Pressure/Temperature test plugs shall be installed across coil.
 6. A Y-strainer or combination strainer and valve shall be installed on the supply side.
 7. Unions shall be used to isolate the coil, AFCV and TCV.
- E. Shutoff Valves (2½" and smaller) shall be forged brass ball valves, Nexus Model UX:
1. A one-piece body rated at 600 psi WP, 325° F.
 2. Interchangeable union ends with FKM O-ring seal (ground joint is not acceptable).
 3. Multiple ¼" tapped ports for test plugs, vent, and/or drain.
 4. Blowout-proof stem with dual KFM O-ring seals.
 5. Hard chrome plated stainless steel ball with Teflon seats.
- F. Shutoff Valves (2½" and larger) shall be lug pattern butterfly valves, Nexus Model BV:
1. A minimum of 225 psi WP, 250° F.
 2. 125# Class lug pattern cast or ductile iron body.
 3. EPDM cartridge seat, 416 stainless steel one-piece shaft, and 304 stainless steel disc.
 4. Top and bottom shaft bushings.
 5. Provide an infinite position chrome plated steel top plate for balancing purposes.
 6. Epoxy coated body.
- G. Automatic Flow Control Valves shall be non-clogging design, Nexus Model UM:
1. The flow cartridge's non-clogging service design shall include no metal-to-metal contact, no segmented ports, and incorporate a flow nozzle and a metering disc controlled by a pressure compensating spring.
 2. The flow cartridge shall be a single assembly, constructed with stainless steel moving parts and be accessible without removing the valve from the piping (½" thru 2½" brass valves).
 3. The flow cartridge shall be 100% factory flow tested and calibrated to maintain an accuracy of ±5%; the accuracy shall be 100% maintained over the operating pressure range.
 4. The flow cartridge shall carry a limited lifetime material warranty.
 5. Valves (2½" and smaller) shall be a forged brass Y-pattern body with ball valve, (2) pressure/temperature ports, a tag indicating the model, flow rate and PSID range, blowout

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- proof stem with dual FKM O-ring seals, interchangeable union end with FKM O-ring seal, hard chrome plated brass ball with Teflon seats, and rated at 600 psi WP, 325° F.
6. Valves (2½" +) shall be a wafer style or 125# / 150# Class flanged cast iron body with (2) pressure/temperature ports, a tag indicating the model, flow rate and PSID range; able to incorporate a drain and/or vent as required; and rated at 175 psi WP, 250° F.
- H. Manual Flow Control Valves (2½" and smaller) shall be a combination of metering/balance type of forged brass construction, Nexus Model XB:
1. A modified venturi equipped with (2) pressure/temperature ports and an ID tag.
 2. A combination shutoff and memory stop device-indicating degree of opening.
 3. A rating of 600 WOG, 325°F.
 4. An interchangeable union ends with FKM O-ring type seal.
 5. Blowout proof stem with dual FKM O-ring seals.
 6. Hard chrome plated stainless steel ball with Teflon seats.
- I. Manual Flow Control Valves (2½" and larger) shall be an instrument and metering station with integral Pitot Tube, multiple ports for instruments, accessories and drains, a butterfly throttling valve; Nexus Model NXFB:
1. The Pitot tube shall be twin tube design, of 316 stainless steel with blowout proof attachment to station body.
 2. Ports shall include ¾" port for thermometer well, ¼" ports for pressure gauge, air vent, transmitter or other accessories, and a ½" drain port.
 3. The instrument station shall be 125# Class flanged (mates to 150# Class flanges) construction.
 4. The butterfly valve shall be lug pattern with a rating 225 PSIG, 250°F.
The butterfly valve shall have an infinite position operator with memory stop (6" and smaller), worm gear with memory stop (6" and larger).
- J. Temperature Control Valves, ref. Section 23 09 00 & 230993.
- K. Combination Strainer/Ball Valves (2½" and smaller) used for supply side shutoff and strainer requirements shall be forged brass construction, Nexus Model UY:
1. A minimum rating of 600 WOG, 325° F.
 2. Interchangeable union end with FKM O-ring seal.
 3. Multiple ¼" tapped ports for test plugs, vent, or other accessories.
 4. Blowout proof stem with dual FKM O-ring seals.
 5. Hard chrome plated stainless steel ball with Teflon seats.
 6. A 20 mesh 304 stainless steel filter screen, accessible without affecting the valve piping.
 7. A port in the filter cap for a blowdown/drain valve.
- L. Combination Strainer/Butterfly Valves (2½" and larger) used for supply side shutoff and strainer requirements shall be cast or gray iron construction, Nexus Model SXFV:
1. A minimum rating of 175 psi WP, 250° F.
 2. 125# Class flanges (mates to 150# Class flanges) and lug pattern butterfly valve.

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3. Multiple ¼" tapped accessory ports across the filter screen.
 4. A flanged end cap with a ¾" port for a blowdown/drain valve standard thru 8" size.
 5. A ¾" port for thermometer well.
 6. A 304 stainless steel screen, with perforations 0.045" thru 3", and 0.125" thru 8".
- M. Y-Strainers (2½" and smaller) shall be forged brass body, Nexus Model UYX:
1. ¼" tapped accessory ports.
 2. A rating of 600 WOG, 325° F.
 3. A 20 mesh 304 stainless steel filter screen, removable without affecting the strainer piping.
 4. A port in the filter cap for a blowdown/drain valve.
- N. Y-Strainers (2½" and larger) shall be 125# Class flanged cast or ductile iron body, Nexus Model SXF:
1. Multiple ¼" tapped accessory ports across the filter screen.
 2. A flanged end cap with a ¾" port for a blowdown valve standard thru 8" size.
 3. A ¾" port for thermometer well.
 4. A 304 stainless steel screen, with perforations 0.045" thru 3", and 0.125" thru 8".
- O. Blowdown/Drain Valves shall be forged brass ball valve construction, Nexus Model BD:
1. A minimum rating of 600 WOG, 325° F.
 2. Blowout proof stem with dual FKM O-ring seals.
 3. Hard chrome plated brass ball with Teflon seats.
 4. A ¾" hose end and nylon / brass cap with retainer to protect threads.
- P. Unions (2" and smaller) shall be forged brass, Nexus Model UU:
1. A minimum of 600 psi WP, 325° F.
 2. Multiple ¼" tapped ports for test plugs, vent and/or drain valves.
 3. FKM O-ring seal.
- Q. Accessories to coil piping components shall conform to the following:
1. Nexus PT Pressure/Temperature test plugs shall be rated for 1000 psi, 325° F, with brass body, Nordel check plugs, and sealed cap.
 2. Flexible hoses shall be designed for water, and fire retarding conform to ASTM codes E84-00, with stainless steel outer braid.
 3. Hoses (½" thru 1"), Nexus UFHF.
 - a. Shall have a Kevlar reinforced EPDM tube core, brass end fittings, and designed for a working pressure of 400 psi, 248°F.
 - b. Provide dual union or swivel end fittings.

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4. Hoses (1¼” thru 2”), Nexus UFHM:
 - a. Shall have Rayon reinforced EPDM tube core, brass end fittings, and designed for a working pressure of 300 psi, 248° F. The (2½”) hose shall have stainless steel outer braid and carbon steel Sch. 40 fittings, and designed for a working pressure of 400 psi, 70° F.
 - b. Provide least one union or swivel end fitting
5. Nexus MV Manual air vents shall be of brass construction and rated at 400 psi, 325° F.
6. Shaft extensions (2” and smaller) for insulated pipe shall be at least 2¼” tall and constructed of brass
7. Chilled water systems: Provide extended pressure and temperature test plugs, manual air vents and handles. Extended handles shall not break the vapor barrier when operated.

2.8 HYDRONIC SPECIALTIES

- A. Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig working pressure; 225 deg F operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 discharge connection and NPS 1/2 inlet connection.
- B. Automatic Air Vent: designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig working pressure; 240 deg F operating temperature; with NPS 1/4 discharge connection and NPS 1/2 inlet connection. Seton, Brady, or approved equal.
- C. Y-Pattern Strainers: Strainers shall be Y-type with removable basket. Body shall have cast-in arrows to indicate direction of flow. Strainer screens shall have finished ends fitted to machined screen chamber surfaces to preclude bypass flow. Strainer element material shall be AISI Type 304 corrosion-resistant steel. Provide fine-mesh start-up strainers. Strainers in sizes 3-inch and smaller shall have screwed ends; Hammond 3010, or approved equal. Body material shall be cast bronze conforming to ASTM B584-C84400. Strainer bodies fitted with screwed screen retainers shall have straight threads and shall be gasketed with nonferrous metal. Strainer screens shall have perforations not to exceed 1/32”. In sizes 4 and larger, strainers shall have flanged ends; Hammond 3030, or approved equal. Body material shall be cast iron conforming to ASTM A126 Class B. Strainer bodies fitted with bolted-on screen retainers shall have offset blowdown holes. Strainer screens shall have perforations not to exceed 1/16” (4” size); 1/8” (5” size and larger).

2.9 WATER TREATMENT FOR CLOSED LOOP HYDRONIC SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Sentinel
 2. Anderson Chemical Company.
 3. Aqua-Chem, Inc.
 4. Barclay Water Management, Inc.
 5. General Electric Company; GE Water & Process Technologies.

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6. H-O-H Water Technology, Inc.
7. Metro Group, Inc. (The); Metropolitan Refining Div.
8. Nalco; an Ecolab company.
9. Watcon, Inc.

B. Performance Requirements

1. Provide water treatment for closed-loop hydronic systems.
2. Water quality for hydronic systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of hydronic equipment without creating a hazard to operating personnel or the environment.
3. Base HVAC water treatment on quality of water available at Project site, hydronic system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.
4. Closed hydronic systems, including shall have the following water qualities:
 - a. pH: Maintain a value within 8.2 to 9.5.
 - b. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
 - c. Total Hardness : <150 ppm as CaCO_3 .
 - d. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
 - e. Soluble Copper: Maintain a maximum value of 0.20 ppm.
 - f. TSS: Maintain a maximum value of 10 ppm.
 - g. Ammonia: Maintain a maximum value of 20 ppm.
 - h. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
 - i. Microbiological Limits:
 - 1) Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/mL.
 - 2) Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/mL.
 - 3) Nitrate Reducers: Maintain a maximum value of 100 organisms/mL.
 - 4) Sulfate Reducers: Maintain a maximum value of zero organisms/mL.
 - 5) Iron Bacteria: Maintain a maximum value of zero organisms/mL.

2.10 GLYCOL

- A. DuPont Dowfrost HD or approved equal; the propylene glycol fluid to be used in such a system shall meet the following requirements: The fluid shall be industrially inhibited propylene glycol (phosphate-based). The fluid shall be easily analyzed for glycol concentration and inhibitor level, and easily re-inhibited using inhibitors readily available from the fluid manufacturer. The fluid shall pass ASTM D1384 (less than 0.5 mils penetration per year for all system metals). The fluid shall be dyed bright yellow to aid in leak detection

PART 3 - EXECUTION

3.1 HYDRONIC PIPING APPLICATIONS – ABOVE GROUND

- A. Condenser Water, NPS 2 and Smaller: Type L drawn-temper copper tubing with soldered joints or Schedule 40 steel pipe with threaded joints.
- B. Condenser Water, NPS 2 ½” and larger: Schedule 40 steel pipe with welded and flanged joints or grooved mechanical-joint couplings.
- C. Drain Lines: ¾” minimum diameter; PVC or DWV Copper Tubing: ASTM B 306, Type DWV.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chain-wheel operators on valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 74 inches above finished floor elevation.

3.3 VALVE APPLICATIONS

- A. Hydronic Valve Applications: Shutoff Duty: Ball and butterfly valves. Throttling Duty: Globe, ball, and butterfly valves.
- B. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.
- C. Install calibrated balancing valves in the return water line of terminal units, as indicated, and as required to facilitate system balancing.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. Install pressure-reducing valves on hot-water generators and elsewhere as required to regulate system pressure.

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3.4 HYDRONIC PIPING INSTALLATIONS

- A. Refer to Division 23 Section "Common Work Results for Mechanical" for basic piping installation requirements.
- B. The drawings show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs at no additional cost. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.
- C. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- D. Refer to Division 23 Section "Common Work Results for Mechanical" for joint construction requirements for soldered and brazed joints in copper tubing; threaded, welded, and flanged joints in steel piping; and solvent-welded joints for PVC and CPVC piping.
- E. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid or flexible, where required, grooved-end-pipe couplings. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by the grooved coupling manufacturer. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. A Victaulic factory trained field representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports."

3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

3.7 CONTROL VALVE INSTALLATION

- A. Perform the following as directed by the BAS contractor:

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1. Install modulating control valves with minimum of 10 pipe diameters straight pipe at inlet and 5 pipe diameters straight pipe at outlet.
 2. Installation of immersion wells and pressure tapplings, along with associated shut-off cocks.
 3. Installation of flow switches.
 4. Setting of automatic control valves or other control devices.
- B. Valve submittals shall be coordinated for type, quantity, size, and piping configuration to ensure compatibility with pipe design.
- C. Slip-stem control valves shall be installed so that the stem position is not more than 60 degrees from the vertical up position. Ball type control valves shall be installed with the stem in the horizontal position.
- D. Valves shall be installed in accordance with the manufacturer's recommendations. Control valves shall be installed so that they are accessible and serviceable and so that actuators may be serviced and removed without interference from structure or other pipes and/or equipment.
- E. Isolation valves shall be installed so that the control valve body may be serviced without draining the supply/return side piping system. Unions shall be installed at all connections to screw-type control valves.

3.8 TERMINAL EQUIPMENT CONNECTIONS

- A. Size for supply and return piping connections shall be same as for equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Arrange piping with offsets to allow for expansion, as well as terminal unit removal.

3.9 CHEMICAL TREATMENT

- A. Perform an analysis of makeup water to determine type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the water characteristics described in Part 2.
- B. Provide bypass chemical feeders in each hydronic system where indicated.
 1. Install in upright position with top of funnel not more than 48 inches above the floor.
 2. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections.
 3. Install NPS 3/4 pipe from chemical feeder drain to nearest equipment drain and include a full-size, full-port, ball valve.
- C. Initial flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system component. Provide temporary piping or hose to

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bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide-out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 6 feet per second, if possible. Connect dead-end supply and return headers as necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect down-stream equipment. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and Contractor's booster pumps. Flush until clean as approved by the commissioning agent.

- D. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water. Circulate systems at normal temperature to remove adherent organic soil, hydrocarbons, flux, pipe mill varnish, pipe joint compounds, iron oxide, and like deleterious substances not removed by flushing, without chemical or mechanical damage to any system component. Removal of tightly adherent mill scale is not required. Keep isolated equipment which is "clean" and where dead-end debris accumulation cannot occur. Sectionalize system if possible, to circulate at velocities not less than 6 feet per second. Circulate each section for not less than four hours. Blow-down all strainers, or remove and clean as frequently as necessary. Drain and prepare for final flushing.
- E. Final Flushing: Return systems to conditions required by initial flushing after all cleaning solution has been displaced by clean make-up. Flush all dead ends and isolated clean equipment. Gently operate all valves to dislodge any debris in valve body by throttling velocity. Flush for not less than one hour.
- F. Close and fill system as soon as possible after final flushing to minimize corrosion. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.
- G. Fill systems that glycol solutions to the concentrations indicated in the equipment schedules.

3.10 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

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5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 3. Isolate expansion tanks and determine that hydronic system is full of water.
 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 6. Prepare written report of testing.
- C. Perform the following before operating the system:
1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Set makeup pressure-reducing valves for required system pressure.
 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 5. Set temperature controls so all coils are calling for full flow.
 6. Inspect and set operating temperatures of hydronic equipment to specified values.
 7. Verify lubrication of motors and bearings.

END OF SECTION 23 21 13

SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 23 Section "Common Work Results"
 - 2. Division 23 Section "Air Cooled Condensing Units"

1.2 SUMMARY

- A. Section Includes:
 - 1. Refrigerant pipes and fittings.
 - 2. Refrigerant piping valves and specialties.
 - 3. Refrigerants.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve, refrigerant piping, and piping specialty.
- B. Shop Drawings:
 - 1. Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes; flow capacities; valve arrangements and locations; slopes of horizontal runs; oil traps; double risers; wall and floor penetrations; and equipment connection details.
 - 2. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
 - 3. Show interface and spatial relationships between piping and equipment.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

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1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to 2010 ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.6 PRODUCT STORAGE AND HANDLING

- A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88, Type K or L, ASTM B 280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Brazing Filler Metals: AWS A5.8/A5.8M.

2.2 VALVES AND SPECIALTIES

- A. Service Valves:
 - 1. Body: Forged brass with brass cap including key end to remove core.
 - 2. Core: Removable ball-type check valve with stainless-steel spring.
 - 3. Seat: Polytetrafluoroethylene.
 - 4. End Connections: Copper spring.
 - 5. Working Pressure Rating: 500 psig.
- B. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory (NRTL).
 - 1. Body and Bonnet: Plated steel.
 - 2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 - 3. Seat: Polytetrafluoroethylene.
 - 4. End Connections: Threaded.
 - 5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and AC coil.

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6. Working Pressure Rating: 400 psig.
 7. Maximum Operating Temperature: 240 deg F.
- C. Thermostatic Expansion Valves: Comply with AHRI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Packing and Gaskets: Non-asbestos.
 4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
 5. Reverse-flow option (for heat-pump applications).
 6. End Connections: Socket, flare, or threaded union.
- D. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Packing and Gaskets: Non-asbestos.
 4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 5. Seat: Polytetrafluoroethylene.
 6. Equalizer.
 7. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter.
 8. End Connections: Socket.
 9. Throttling Range: Maximum 5 psig.
 10. Working Pressure Rating: 500 psig.
 11. Maximum Operating Temperature: 240 deg F.
- E. Moisture/Liquid Indicators:
1. Body: Forged brass.
 2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
 3. Indicator: Color coded to show moisture content in parts per million (ppm).
 4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
 5. End Connections: Socket or flare.
 6. Working Pressure Rating: 500 psig.
 7. Maximum Operating Temperature: 240 deg F.
- F. Replaceable-Core Filter Dryers: Comply with AHRI 730.
1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
 2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
 3. Desiccant Media.
 4. Designed for reverse flow (for heat-pump applications).
 5. End Connections: Socket.
 6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.

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7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 240 deg F.

PART 3 - EXECUTION

3.1 VALVE AND SPECIALTY APPLICATIONS

- A. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 1. Install valve so diaphragm case is warmer than bulb.
 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- B. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

3.2 PIPING INSTALLATION

- A. 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 Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- 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 adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.

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- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection.
- L. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- M. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- N. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

3.3 PIPE 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 pipe and fittings before assembly.
- C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
- D. Braze Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube." Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

3.4 HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hangers and supports specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments: Adjustable steel clevis hangers. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:

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1. NPS 1/2: Maximum span, 60 inches; minimum rod, 1/4 inch.
2. NPS 5/8: Maximum span, 60 inches; minimum rod, 1/4 inch.
3. NPS 1: Maximum span, 72 inches; minimum rod, 1/4 inch.
4. NPS 1-1/4: Maximum span, 96 inches; minimum rod, 3/8 inch.
5. NPS 1-1/2: Maximum span, 96 inches; minimum rod, 3/8 inch.
6. NPS 2: Maximum span, 96 inches; minimum rod, 3/8 inch.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

B. Prepare test and inspection reports.

3.6 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

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3.7 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of controllers to the system design temperature.

END OF SECTION 23 23 00

SECTION 23 31 13 - DUCTWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 8 for Access Doors
 - 2. Division 23 Section "Common Work Results for Mechanical"
 - 3. Division 23 Section "Mechanical Insulation"
 - 4. Division 23 Section "Air Terminals"
 - 5. Division 23 Section "Diffusers, Registers, and Grilles."
 - 6. Division 23 Control Section
 - 7. Division 23 Section "Testing, Adjusting, and Balancing".

1.2 SUMMARY

- A. This Section includes ducts and accessories.

1.3 SYSTEM DESCRIPTION

- A. Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions, which may be altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.
- B. The contractor must comply with the enclosed specification in its entirety. If on inspections, the engineer finds changes have been made without prior written approval, the contractor will make the applicable changes to comply with this specification, at the contractor's expense.
- C. At the discretion of the engineer, sheet metal gauges, and reinforcing may be randomly checked to verify all duct construction is in compliance.

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1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", ASCE/SEI 7, and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1. Exception: Sheet metal surfaces and fasteners.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.
 - 3. Seismic-restraint devices.
- B. Shop Drawings:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Factory- and shop-fabricated ducts and fittings.
 - 3. Fittings.
 - 4. Reinforcement and spacing.
 - 5. Seam and joint construction.
 - 6. Penetrations through fire-rated and other partitions.
 - 7. Equipment installation based on equipment being used on Project.
 - 8. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
- C. Delegated-Design Submittal:
 - 1. Sheet metal thicknesses.
 - 2. Joint and seam construction and sealing.
 - 3. Reinforcement details and spacing.
 - 4. Materials, fabrication, assembly, and spacing of hangers and supports.
- D. Ductwork Specialties Product Data; provide for the following:
 - 1. Sealant
 - 2. Duct Liner

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3. Duct-mounted access doors and panels.
4. Flexible ducts.
5. Backdraft dampers.
6. Manual-volume dampers: Damper manufacturer's printed application and performance data including pressure, velocity and temperature limitations shall be submitted for approval.
7. Life Safety dampers: Provide complete submittal information (including installation instructions) and the manufacturer's certification of compliance with these specifications for approval prior to bidding. Contractor shall include damper manufacturer's Installation Instructions as part of the submittal. These instructions shall describe the applicable requirements for damper sleeve thickness, retaining angles, and methods of attachment, duct-to-sleeve connections, preparation of wall or floor openings, and all other requirements to provide an installation equivalent to that tested by the damper manufacturer during the UL Standard 555 qualification procedures. Contractor shall detail any proposed installations that deviate from these manufacturer's instructions and explain the needed deviations.
8. Duct Silencers: The manufacturer shall supply certified test data for each scheduled silencer. The data shall include dimensions, weights, dynamic insertion loss, generated noise and pressure drop for forward or reverse flow, matching the project's air distribution system requirement. All ratings shall be conducted in the same facility and shall utilize the same silencer. Silencer performance must have been substantiated by laboratory testing according to ASTM E-477-99 and so certified when submitted for approval.
9. Louvers: Include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals. For units with factory-applied color finishes, provide color chart. Provide product test reports: Based on evaluation of comprehensive tests performed by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver.

1.6 INFORMATIONAL SUBMITTALS

- A. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- B. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.8 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. National Fire Protection Association (NFPA)
 - 1. 90A: Standard for the Installation of Air Conditioning and Ventilating Systems
 - 2. 96-2008: Ventilation Control and Fire Protection of Commercial Cooking Operations
- D. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
 - 1. 3rd Edition: 2005 HVAC Duct Construction Standards, Metal and Flexible
 - 2. 1st Edition: 2012 ANSI/SMACNA 016-2012 HVAC Air Duct Leakage Test Manual

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sealant and fire stopping materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.
- B. Deliver, store and handle materials according to manufacturer's written recommendations.
- C. All ductwork, equipment, and fittings delivered and stored on the job site must be capped to prevent the entry of moisture, construction dust or other debris.

PART 2 - PRODUCTS

2.1 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. Galvanized Coating Designation: G60 or G90 as indicated. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A-1008M, with oiled, matte finish for exposed ducts.

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- D. 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 as indicated in the "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Reinforcement Shapes and Plates: ASTM A-36/A-36M, steel plates, shapes, and bars; black and galvanized.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of un-braced panel area, unless ducts are lined. All large ducts must be braced as required to prevent drumming.
- E. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fig. 2-3 Rectangular Elbows: Type RE2 square throat with vanes, Type RE1 radius (1.5W minimum), or Type RE5 dual radius. Square throat is not allowed.
 - 2. Vane support in elbows: Fig 2-4. Turning vanes shall be Harper double wall turning vanes fabricated from the same material as the duct. Mounting rails shall have friction insert tabs that align the vanes automatically. Tab spacing shall be as specified in Figure 2-3 of the 1995 SMACNA Manual, "HVAC Duct Construction Standards, Metal &

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Flexible” Second Edition standard. Rail systems with non-standard tab spacing shall not be accepted. Due to tensile loading, vanes shall be capable of supporting 250 pounds when secured according to the manufacturer’s instructions.

3. Fig. 2-5 Rectangular Divided Flow Branches: Type 1, Type 2, Type 4A, or 4B.
4. Fig. 2-6 Branch Connections: 45-degree entry, 45-degree lead-in, bell-mouth or spin-in (single diffuser supply only).
5. Fig. 2-7 Offsets and Transitions. Use gradual offsets as shown, 90-degree offsets shall be avoided.
6. Fig 2-9 Duct Coils: Duct coils with transitions and upstream access door as shown.

2.3 ROUND DUCT FABRICATION

- A. Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" latest edition.
- B. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 1. Exposed Round Ducts: Shall be Spiral Seam (RL-1 seam) at 2-inch wg construction.
 2. Concealed Round Ducts: Shall be longitudinal Grooved Seam Flat lock (RL-5 seam) at 2-inch wg construction.
 3. Snap lock seams shall not be used for this project.
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 HANGERS AND SUPPORTS

- A. Hanger Rods: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Outdoor Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A-603. 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.

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- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.
- G. Supports For Roof Mounted Items:
 - 1. Equipment rails shall be galvanized steel, minimum 18-gauge, with integral baseplate, continuous welded corner seams, factory installed 2x4 treated wood nailer, 18-gauge galvanized steel counter flashing cap with screws, built-in cant strip; minimum height 11 inches. Provide raised cant strip to start at the upper surface of the insulation.
 - 2. Pipe/duct pedestals: Provide a galvanized unistrut channel welded to U-shaped mounting brackets which are secured to side of rail with galvanized lag bolts.

2.5 SEALANT MATERIALS

- A. Joint Sealant/Mastic: Shall be flexible, water-based, adhesive sealant designed for use in all pressure duct systems. After curing, it shall be resistant to ultraviolet light and shall prevent the entry of water, air and moisture into the duct system. Sealer shall be UL 723 listed; UL 181A-M or 181B-M listed; and meet NFPA 90A requirements. Pressure sensitive tape shall not be used as a sealing mechanism.
 - 1. Maximum 5 flame spread and 0 smoke-developed (ASTM E-84 Tunnel Test).
 - 2. Generally provide liquid sealant for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger.
 - 3. Resistance to mold, mildew and water: Excellent
 - 4. Color: Gray
 - 5. Duct sealant/mastic shall meet requirement for “LEED IEQ Credit 4.1: Low Emitting Materials: Adhesive and Sealant”. ITW TACC Miracle Kingco water-based sealants, or approved equal.
- B. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- C. Round Duct Joint O-Ring Seals: 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. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

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2.6 FITTINGS

- A. Tees, Laterals, and Conical Tees: Use 45 degree; fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal seam straight duct.
- B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from body onto branch tap entrance.
- C. Elbows: Diameters 3 through 8 inches shall be two-section die stamped; all others shall be gored construction, maximum 18 degree angle, with all seams continuously welded or standing seam. Coat galvanized areas of fittings damaged by welding with corrosion resistant aluminum paint or galvanized repair compound.
- D. Low-point drains: Ductmate moisture drain with funnel collection design; ¾" connection with drain fitting and cap.

2.7 BACKDRAFT DAMPERS

- A. Gravity: Ruskin BD2/A2.
 - 1. Frame: 0.090-inch- thick extruded aluminum, with mounting flange.
 - 2. Blades: 0.025-inch- thick, roll-formed aluminum, with extruded-vinyl seals, Zytel bearings.
 - 3. Tie Bars and Brackets: Aluminum.
 - 4. Return Spring: Adjustable tension.
- B. Counter Balanced: Ruskin CBD4; weather resistant for relief air applications; Adjustable counterbalance weights which enable the damper to operate in the range of .01" to .05" w.g.
 - 1. Frame: 0.081"-inch- thick 6063-T5 extruded aluminum, with mounting flange.
 - 2. Blades: 0.070-inch- thick, roll-formed 6063-T5 aluminum, with extruded-vinyl seals, Zytel bearings.
 - 3. Tie Bars and Brackets: Aluminum.

2.8 LOUVERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ruskin Company
 - 2. American Warming and Ventilating, Inc.
 - 3. Arrow United Industries.
 - 4. Cesco Products.
 - 5. Construction Specialties, Inc.
 - 6. Greenheck.

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- B. Louvers shall be AMCA Licensed. Louvers shall comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.
- C. Fabrication: Design: Stationary drainable louver type with drain gutters in each blade and head with downspouts in jambs and mullions with all welded construction. Hidden vertical supports to allow continuous line appearance up to 120 inches. Steeply angled integral sill. Frame Depth: 4 inches; Wall Thickness: 0.081 inch nominal. Material: Extruded aluminum, Alloy 6063-T6. Blades: Style: Drainable. 45 degrees at 4 inches nominal. Wall Thickness: 0.081 inch nominal. Material: Extruded aluminum, Alloy 6063-T6. Recycled Content: 18% post-consumer, 55% pre-consumer, post-industrial, total 73% by weight.
- D. Performance Data: Based on testing 48 inch x 48 inch size unit in accordance with AMCA 500.
1. Free Area: 52 percent, nominal.
 2. Free Area Size: 8.34 square feet.
 3. Maximum Recommended Air Flow through Free Area: 1075 feet per minute.
 4. Air Flow: 8966 cubic feet per minute.
 5. Maximum Pressure Drop (Intake): 0.225 inches w.g.
 6. Water Penetration: Maximum of 0.01 ounces per square foot of free area at an air flow of 1075 feet per minute free area velocity when tested for 15 minutes.
 7. Design Wind load: Per Code.
 8. Louvers shall be factory engineered to withstand the specified seismic loads. Minimum design loads shall be calculated to comply with ASCE – 7, or local requirements of Authority Having Jurisdiction (AHJ).
- E. Bird Screen: aluminum, 5/8" mesh, removable frame, re-wireable.
- F. Premium Kynar Paint Finish: Before paint application, louvers shall be thoroughly cleaned and pretreated. Cleaning includes complete submersion in alkali cleaner, detergent deoxidization, amorphous chrome phosphate conversion ® ® coating and acidulated final rinse. Kynar 500 or Hylar 5000 finish shall be applied to provide 1.2 mils factory applied, baked-on film build in accordance with AAMA 2605-98* "Voluntary Specification Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Architectural Extrusions and Panels". Color shall be as selected by Architect.
- G. Accessories
1. Insulated Blank-Off Panels: 0.040 aluminum sheet, 2 inches thick, aluminum skin insulated core, factory installed with removable fasteners and neoprene gaskets.
 2. Aluminum Insect Screen - 18-16 mesh, mill finish, .011 inch wire.

2.9 MANUAL-VOLUME DAMPERS

- A. Manual balancing dampers meeting the following specifications shall be furnished and installed on all branch ducts and where shown on plans. Testing and ratings to be in accordance with AMCA Standard 500-D.

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- B. Single-Blade Rectangular Dampers shall consist of: an 18 ga. galvanized steel frame with 3-1/2 in. depth; blades fabricated from 20 ga. galvanized steel; integral 1/2 in. diameter axles. Damper suitable for pressures to 1.0 in. wg, velocities to 2000 fpm and temperatures to 180°F. Basis of design is Greenheck model MBD-10.
- C. Multi-Blade Rectangular Dampers shall consist of: a 16 ga. galvanized steel hat channel frame with 5 in. depth; triple V type blades fabricated from 16 ga. galvanized steel; 1/2 in. dia. plated steel axles; external (out of the airstream) blade-to-blade linkage. Damper suitable for pressures to 4.0 in. w.g. (996 Pa), velocities to 2000 fpm and temperatures to 180°F. Basis of design is Greenheck model MBD15.
- D. Round dampers shall consist of: a 20 ga. galvanized steel frame with 6 in. depth; blades fabricated from 20 ga. galvanized steel; 3/8 in. square plated steel axles turning in acetal bearings. Damper suitable for pressures to 1.0 in. wg, velocities to 2000 fpm and temperatures to 180°F. Basis of design is Greenheck model MBDR50.

2.10 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.
 - 2. Cesco Products
 - 3. Greenheck Fan Corporation.
 - 4. METALAIR, Inc.
 - 5. Nailor Industries Inc.
 - 6. Prefco
 - 7. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555S by an NRTL.
- C. Dynamic dampers: Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating: 1-1/2 hours.
- E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory-provided.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

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- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165°F rated, fusible links.

2.11 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. McGill Air Flow LLC.
 - 4. Nailor Industries Inc.
 - 5. Durodyne
 - 6. Cesco
 - 7. Buckley
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
 - 1. Door: Double wall, rated for up to 4.5" static pressure. Door panel filled with 1" fiberglass insulation; ¾ lb. density. Hinges and Latches: 1-by-1-inch continuous piano hinge and cam latches. Fabricate doors airtight and suitable for duct pressure class.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs.
 - 3. Provide 1/8" thick neoprene gaskets.
 - 4. Locks: Access doors less than 16 Inches Square: Two cam locks. Doors over 16" shall have four locks.

2.12 FLEXIBLE CONNECTORS

- A. Provide for all air moving equipment. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 0 or 1. Factory fabricated with a strip of fabric 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized, sheet steel or 0.032-inch aluminum sheets. Select metal compatible with connected ducts. Duro-Dyne, Hardcast, or approved equal.
- B. Indoor Flexible Connector Fabric: Glass fabric double coated with polychloroprene or neoprene. Minimum Weight: 26 oz. /sq. yd. Tensile Strength: 480 lbf/inch in the warp, and 360 lbf/inch in the filling.

2.13 FLEXIBLE DUCTS

- A. General: Comply with UL 181, Class 0 or 1. Flame Spread: Less than 25; Smoke Developed: Less than 50.

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- B. All products shall be certified by Greenguard Environmental Institute; independent testing of products for emissions of respirable particles and Volatile Organic Compounds (VOC's), including formaldehyde and other specific product-related pollutants. Greenguard provides independent, third-party certification of IAQ performance. Certification is based upon criteria used by EPA, OSHA and WHO.
- C. Rated Positive Pressure: 10" w.g. per UL-181. Maximum negative pressure: 3/4".
- D. Flexible Ducts, Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing glass-fiber insulation around a continuous inner liner.
 - 1. R6 insulation, Basis of Design: Atco #86
 - 2. Reinforcement: Steel-wire helix encapsulated in inner liner.
 - 3. Jacket (inner and outer): Polyethylene film.
- E. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches to suit duct size.
- F. Hangers shall be band type, 1" wide minimum.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION, GENERAL

- A. Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets at no additional cost. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions which shall be altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.
- B. Provide volume dampers at all branch ducts to RGD's. If volume dampers are inadvertently not shown, contractor shall provide, the intent is to provide volume dampers at all branches.
- C. Provide ducts and accessories according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- D. Construct and install each duct system for the specific duct pressure classification indicated.
- E. Properly seam, brace, stiffen, support and render ducts mechanically airtight. Adjust ducts to suit job conditions. Dimensions may be changed as approved, if cross sectional area is maintained.

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- F. Provide ducts in lengths not less than 12 feet, unless interrupted by fittings. Provide ducts with fewest possible joints.
- G. Provide fabricated fittings for changes in directions, changes in size and shape, and connections.
- H. Provide couplings tight to duct wall surface with a minimum of projections into duct.
- I. Provide ductwork to allow maximum headroom. Provide ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Provide ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- J. Provide ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- K. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions, unless specifically indicated.
- L. Coordinate layout with suspended ceiling, lighting layouts, and similar finished work.
- M. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Hangers Exposed to View: Threaded rod and angle or channel supports.
- C. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system. Seal duct joints to prevent dirt marks.
- D. 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.
- E. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- F. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 MATERIALS

- A. Hangers, accessories, and dampers shall be same material as parent duct.
- B. Refer to Specification Section 23 07 00 for sheet metal covering of rigid insulation for protection from maintenance personnel crossing insulated ductwork in mechanical spaces.

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- C. All ducts shall be G60 galvanized steel except as follows:
1. Louver sleeves and plenums: G90 galvanized steel.
 2. Exposed Ductwork: Galvaneal (ready for paint)
 3. Plenums at outside louvers: G90 galvanized steel, water-tight, pitched to drain. Provide low-point drain fittings at low points.

3.4 DUCT CLASSIFICATIONS AND SEALING

- A. Static-Pressure Classifications: Unless otherwise indicated, construct ducts to the following:
1. Supply Ducts: 2-inch wg.
 2. Return Ducts: 2-inch wg, negative pressure.
 3. Exhaust Ducts: 2-inch wg, negative pressure.
- B. Seam And Joint Sealing
1. General: Seal duct seams and joints according to the duct pressure class indicated and as described in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
 2. Seal to SMACNA Class A; all joints, longitudinal and transverse seams, and connections in ductwork shall be securely fastened and sealed with welds, gaskets, or duct sealant. Exceptions:
 - a. Continuously welded and locking-type longitudinal joints and seams on ducts operating at less than 2 in. wg pressure classification.
 - b. Exposed exhaust or return ducts operating at less than 2 in. wg pressure classification.
 - c. Exposed supply ducts in the space that the duct serves.
 3. Seal externally insulated ducts before insulation installation.

3.5 DUCT PENETRATIONS

- A. Fire or Smoke Rated Penetrations not requiring a fire and/or smoke damper: Where ducts pass through walls, floors, or partitions that are required to have a fire resistance rating and fire dampers are not required, the opening in the construction around the duct shall be as follows:
1. Not exceeding a 1" average clearance on all sides.
 2. Filled solid with firestopping material as specified in Section 23 05 00.
- B. Fire or Smoke Rated Penetrations: Provide fire and/or smoke damper as specified under Duct Accessories paragraph.
- C. Non-Fire-Rated Exposed Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same metal thickness as duct. Overlap opening on four sides by at least 1-1/2 inches.

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- D. Non-Fire-Rated Concealed Penetrations: Provide insulation infill and acoustical sealant around gaps. Tightly seal to prevent sound transmission. Neatly finish.
- E. Mechanical room floor penetrations: Provide 4-inch high concrete curbs or other sealing method to prevent leakage from mechanical room into floor penetration.
- F. Roof penetrations by ducts shall use counter-flashed curbs.
- G. Flexible air ducts or connectors shall not pass through any wall, floor, or ceiling.

3.6 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. Provide 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. 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.
- E. Provide upper attachments to structures. Select and size upper attachments with pull-out, tension,

3.7 FLEXIBLE DUCT

- A. Provide in accordance with manufacturer's and Air Diffusion Council recommendations.
- B. Flexible ducts shall be supported at manufacturer's recommended intervals, but at no greater distance than 5 feet. Maximum permissible sag is ½" per foot of spacing between supports.

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- C. Provide duct fully extended; do not install in the compressed state or use excess lengths.
- D. Avoid bending ducts across sharp corners or incidental contact with metal fixtures, pipes, conduits, or hot equipment. Radius at centerline shall not be less than one duct diameter.
- E. Hanger or saddle material in contact with the duct shall be at least 1-1/2" wide.
- F. Provide at least 2 duct diameters of straight duct at the entrance to register, grilles, and diffusers.

3.8 DUCT ACCESSORIES INSTALLATION

- A. Provide duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible".
- B. Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards
- C. Each register, grille, or diffuser shall have a means of air flow adjustment. Provide volume damper in branch duct if not furnished with the RGD.
- D. Adjust operable devices for proper action.
- E. Perform the following as directed by the controls contractor:
 - 1. Installation of control devices
 - 2. Access doors where indicated and as required.
- F. Provide duct access panels for access components that require servicing.
 - 1. Provide duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining per equipment manufacturers' requirements.
 - 2. Provide access panels on side of duct where adequate clearance is available.
 - 3. Locate panel upstream and/or downstream as recommended by manufacturer.
 - 4. Locations:
 - a. On both sides of duct coils.
 - b. Upstream from duct filters.
 - c. At outdoor-air intakes.
 - d. At drain pans and seals.
 - e. Adjacent to and close enough to life safety dampers, to reset or reinstall fusible links. Access doors for access to dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - f. Control devices requiring inspection.
 - g. Elsewhere as indicated or required by duct accessory manufacturer

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5. Inspect locations of access doors and verify that purpose of access door can be performed.

G. Control Damper Installation

1. Damper submittals shall be coordinated for type, quantity, and size to ensure compatibility with sheet metal design.
2. Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting. Duct openings shall measure ¼ in. larger than damper dimensions and shall be square, straight, and level.
3. Individual damper sections, as well as entire multiple section assemblies, must be completely square and free from racking, twisting, or bending. Measure diagonally from upper corners to opposite lower corners of each damper section. Both dimensions must be within 1/8 in. of each other.
4. Follow the manufacturer's instructions for field installation of control dampers. Unless specifically designed for vertical blade application, dampers must be mounted with blade axis horizontal.
5. Damper blades, axles, and linkage must operate without binding. Before system operation, cycle damper after installation to ensure proper operation. On multiple section assemblies, all sections must open and close simultaneously.
6. Provide a visible and accessible indication of damper position on the drive shaft end.
7. Support ductwork in area of damper when required to prevent sagging due to damper weight.
8. After installation of low-leakage dampers with seals, caulk between frame and duct opening to prevent leakage around perimeter of damper.

H. Fire Damper Installation

1. Examine areas to receive dampers. Notify the Engineer of conditions that would adversely affect installation or subsequent utilization of dampers. Do not proceed with installation until unsatisfactory conditions are corrected
2. Provide dampers in accordance with manufacturer's UL Installation Instructions, labeling, and NFPA 90A at locations indicated on the drawings. Any damper installation that is not in accordance with the manufacturer's UL Installation Instructions must be approved prior to installation.
3. Dampers must be accessible to allow inspection, adjustment, and replacement of components. The sheet metal contractor shall furnish any access doors in ductwork or plenums required to provide this access. The general contractor shall furnish any access doors required in walls, ceilings, or other general building construction.
4. Provide dampers square and free from racking.
5. The installing contractor shall provide and install bracing for multiple section assemblies to support assembly weight and to hold against system pressure.
6. Do not compress or stretch the damper frame into the duct or opening.
7. Attach multiple damper section assemblies together in accordance with manufacturer's instructions. Provide support mullions as reinforcement between assemblies as required.
8. Handle dampers using the frame or sleeve. Do not lift or move dampers using blades, actuator or jackshaft.
9. Provide access door, properly located for serving.

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10. Tests and Inspections: Operate dampers to verify full range of movement and verify that proper heat-response device is installed.

3.9 LOUVER INSTALLATION

- A. Louvers to be furnished by Division 23; mounted and installed by the contractor responsible for the outside wall construction. Ductwork shall be connected to the louvers by Division 23.
- B. Verify louver openings by field measurements before fabrication and indicate measurements on Shop Drawings. For new construction, or where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating louvers without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to established dimensions. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.
- C. Installation
 1. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.
 2. Pitch horizontal ducts and plenums connected to louvers downward toward louvers not less than 1 inch in 10 feet. Connect to louver to allow drainage to exterior. Seal duct water-tight.
 3. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather tight connection.
 4. Form closely fitted joints with exposed connections accurately located and secured.
 5. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
 6. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
 7. Provide concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weather tight louver joints are required.
- D. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

3.10 FIELD QUALITY CONTROL

- A. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

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- B. HVAC systems shall not be operated during construction.
- C. Systems shall not be operated without filters in place.
- D. Upon completion of installation duct systems and before HVAC system start-up, visually inspect the ductwork proper installation
- E. Cover supply openings with filter media prior to system start-up to catch any loose material that may remain inside the ductwork. Turn the HVAC system on and allow it to run until steady state operation is reached. Remove the temporary filter media from supply openings and, along with it, any loose material blown downstream and caught by the filter media.
- F. All ductwork shall be provided with temporary enclosures to keep the HVAC system free of dust and construction debris. The HVAC system includes any interior surface of the facility's air distribution system for conditioned spaces and/or occupied zones. This includes the entire duct from the points where the air enters the system to the points where the air is discharged from the system.
- G. Check all filters in accordance with their manufacturer's instructions. Use specified grade of filters at all times that system is operating.

END OF SECTION 23 31 13

SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 23 Section "Common Work Results for HVAC"
 - 2. Division 23 Section "Ductwork"
 - 3. Division 23 Section "Testing, Adjusting, and Balancing" for balancing diffusers, registers, and grilles.

1.2 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

1.3 DEFINITIONS

- A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.
- B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.
- C. Register: A combination grille and damper.

1.4 SUBMITTALS

- A. Each manufacturer shall check noise level ratings for registers and diffusers to insure that the sizes selected will not produce noise to exceed 30 db, "A" scale, measured at occupant level; notify Owner's representative of problems prior to shop drawing submittal.
- B. Pressure drop, airflow and noise criteria selection is based on design equipment. Manufacturers not submitting design makes must provide written certification in front of submittal that equipment submitted has been checked against and performs equal to the design make.

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- C. Product Data: For each model indicated, include the following:
 - 1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
 - 2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
 - 3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
 - 4. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.
- D. Coordinate locations with reflected ceiling plans and wall elevations as applicable.
- E. Coordinate mounting frame with associated mounting surface.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the systems indicated. Other manufacturers' products with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."
- B. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."
- C. Sound pressure levels shall be determined by using AHRI Standard 885-2008 "Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Outlets".

PART 2 - PRODUCTS

2.1 GENERAL

- A. Diffusers, registers, and grilles are scheduled on Drawings.
- B. Mounting type shall match the mounting surface. Coordinate with mounting conditions.
- C. Material shall match the specified ductwork. Coordinate with Section 23 31 13 "Ductwork".
- D. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."
- E. Provide with a White Powder Coat finish, unless noted otherwise.

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- F. Grille blade orientation: Vertical rectangle (wall grille with height longer than width): The blades shall run parallel to the short dimension of the grille. Horizontal rectangle: The blades shall run parallel to the long dimension of the grille.

- G. Manufacturers
 - 1. Price
 - 2. Titus
 - 3. Metal-Aire
 - 4. Anemostat
 - 5. Nailor

2.2 RETURN OR EXHAUST

- A. Return/Exhaust Grille, 45-degree deflection
 - 1. Material: steel (Price 530 Series) or aluminum (Price 630 Series)
 - 2. Provide damper as scheduled.
 - 3. Grilles of the sizes indicated on the plans. Grilles shall be 45 degree deflection fixed louver type with blades spaced 3/4" on center.

2.3 SUPPLY

- A. Square ceiling diffusers, Fixed pattern
 - 1. Material: steel (Price Model SCD) or aluminum (Price Model ASCD)
 - 2. Diffusers shall consist of a precision formed back cone of one piece seamless construction which incorporates a round inlet collar of sufficient length for connecting rigid or flexible duct.
 - 3. The diffuser shall integrate with all duct sizes shown on the plans without affecting the face size and appearance of the unit. An inner cone assembly shall consist of 3 cones (or optional 4 cones) which drop below the ceiling plane to assure optimal VAV air diffusion performance.
 - 4. The inner cone assembly shall be completely removable from the diffuser face to allow full access to any dampers or other ductwork components located near the diffuser neck.

- B. Square flat face (Plaque) Diffusers
 - 1. Price model (SMDP steel) ceiling diffusers of sizes and mounting types designated by the plans and air distribution schedule.
 - 2. Diffusers shall consist of a precision formed back cone of one piece seamless construction which incorporates a round inlet collar of sufficient length for connecting rigid or flexible duct. An inner plaque assembly shall be incorporated that drops no more than 1/4" below the ceiling plane to assure proper air distribution performance.
 - 3. The inner plaque assembly shall be completely removable from the diffuser face to allow full access to any dampers or other ductwork components located near the diffuser neck.

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C. Double-deflection Supply Register

1. Material: steel (Price 520D Series) or aluminum (Price 620D Series)
2. Grilles of the sizes indicated on the plans.
3. Registers shall be double deflection type with two sets of fully adjustable deflection blades spaced $\frac{3}{4}$ " on center.

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. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
- B. Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of the panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Provide diffusers, registers, and grilles with airtight connection to ducts.
- D. Provide 2 feet minimum of straight ductwork at the entrance to diffusers.
- E. Plenum boxes on grilles/registers shall be 8" minimum height.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.
- B. Adjustable outlet diffuser: adjust pattern for draft-free air distribution.

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3.4 CLEANING

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 23 37 13

SECTION 23 65 00 - FLUID COOLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Division 23 Section "Common Work Results for Mechanical"

1.2 SUMMARY

- A. This Section includes factory-fabricated, packaged, closed circuit, mechanical-draft fluid coolers.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, pressure drop, fan performance data, accessories, installation instructions, startup instructions, and furnished specialties for each model indicated.
- B. Coordination Drawings: Show structural supports, piping roughing-in requirements, wiring roughing-in requirements (determine spaces reserved for electrical equipment), and access requirements for service and maintenance.
- C. Maintenance Data: For each fluid cooler to include in maintenance manuals specified in Division 1. Include part lists for unit coil, water distribution system, pump, fans, bearings, fan drives, vibration isolators, controls, basin heaters, and accessories.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled according to NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- B. ASME Compliance: Fabricate and label heat-exchange coils complying with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- C. Comply with NFPA 70 for components and installation.

1.5 COORDINATION

- A. Coordinate installation of equipment supports.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fluid cooler as a factory-assembled unit with protective crating and covering.
- B. Rig units for unloading and moving as recommended by equipment manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. SPX Cooling Technologies, Inc (Basis of Design)
 - 2. Baltimore Aircoil Co.
 - 3. Evapco, Inc.
 - 4. Marley Cooling Tower Co.
- B. Although alternate manufacturers to the basis of design are listed, the alternate manufacturers must meet all specified requirements for the Basis of Design and shall interface with operation of the existing fluid cooler for control as outlined in Section 230993.

2.2 COMPONENTS

- A. Select one of three "coil" paragraphs below. Copper and stainless-steel coils are also available.
- B. General Information: The unit shall be a SPX Cooling Technologies RECOLD forced draft, centrifugal fan, counterflow Closed Circuit Fluid Cooler model JW-35C, or approved equal. The unit shall be of low profile design with a single fan mounted on the end of the unit for convenient access by service personnel. The unit ships completely factory assembled with optional accessories factory installed unless specified otherwise.
- C. Capacity: As scheduled on the drawings.
- D. Coil Section: The Closed Circuit Fluid Cooler coil shall be constructed entirely of copper to provide superior corrosion resistance. The tubes are made up of 5/8" O.D. copper tubing and type L headers. The coil shall be supported by stainless steel tube sheets and high temperature grommet inserts that allow the coil to move within the insert. The coil is then pressurized to 350 P.S.I. and submerged under water for 30 minutes to assure a leak-free coil.

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- E. Construction: The Closed Circuit Fluid Cooler Sump Pan shall be constructed of heavy gauge, series 301L (low carbon) stainless steel. The casing panels shall be constructed of heavy gauge G-235 galvanized steel. The sump pan and casing panels are all flanged outward so that all the connecting fasteners are located outside the flooded section of the unit. This helps to prevent leaks in the unit and provides a more permanent watertight joint. To provide further protection from corrosion, use no welded joints below the water line. The unit is designed for a 30 psf on any projected area and ships in one piece on a minimum 6" high galvanized steel channel base to help in handling and installation of the unit.
- F. Accessibility: The unit shall have as standard 19"x27" stainless steel access doors that provide a watertight seal without the use of gaskets or fasteners. A minimum of 4 doors shall be provided.
- G. Fan Section: The unit design shall have the fan wheel and motor and drive components in the dry, entering airstream. This will extend the service life of the unit and allows easy access to the drive system. The fan wheel shall be statically and dynamically balanced and mounted on a solid steel fan shaft supported on each end with self-aligning heavy-duty pillow block bearings. The bearings are rated for 200,000-hour life. Provide extended grease lines for easy maintenance. The v-belt drive system shall be designed for 150% of motor horsepower and the fan housing shall be equipped with curved inlet rings for maximum efficiency.
- H. Fan Motor: The fan motor provided is an energy efficient type as standard and meets new governmental EPACK efficiency standards, TEFC motor suitable for outdoor usage 10 hp motor suitable for service on 208 volts, 3 phase 60-hertz systems.
- I. Water Distribution Systems: The unit spray distribution system shall be designed to evenly distribute the spray water over the coil, continuously wetting the coil. The spray nozzles shall be made of PVC and are of a large-orifice design to help prevent clogging. The spray nozzle shall distribute the water in a full 360-degree radius for maximum distribution. The internal piping is minimum schedule 40 PVC to prevent spray system corrosion. The spray system piping will extend through the unit casing to allow flushing of the system when needed. The spray nozzles, which shall be attached to the piping with stainless steel clamps, can be inspected or removed through one of the stainless steel access doors. The re-circulating unit pump shall be a close-coupled, centrifugal type pump that uses a mechanical seal. A stainless steel anti-vortexing hood shall be provided on pump suction. The pump is specifically sized for the spray system and is located on the unit skid for easy access. The pump motor shall be a TEFC, 1 hp motor suitable for service on 208 volts, 3 phase 60-hertz systems.
- J. Make-Up Water System: The unit shall use a solid brass make-up water valve with a large diameter plastic float that is located on the exterior of the sump pan, allowing easy inspection and extended service life. The make-up valve is positioned above the overflow connection so that backflow preventors are not required.
- K. Drift Eliminators: The drift eliminators are made from heavy duty PVC for superior corrosion resistance and are installed sectionally to allow easy handling by maintenance personnel. The eliminator design has 3 changes in airflow direction and has a drift rating of about .002% of the spray water re-circulation rate.

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- L. Sump Pan Heater Package: Provide a sump pan heater to provide 40 deg. F. sump pan water temperature at a -10 deg. F. dry bulb temperature. The package shall include immersion heater, low water cutout switch and submersible bulb thermostat. Components shall be wired to factory installed control-starter panel.
- M. VFD and Controls: Field mounted VFD and control for the new and existing tower shall be by the facility BAS, as specified in Section 230993.
- N. Positive Closure Damper Assembly: Unit provided with low profile (not to exceed 6-1/2") damper assembly installed on discharge outlet area of the unit. Package to include damper blade assembly, linkage and damper actuators. Designed to help prevent convection through the unit when unit not in use.

2.3 FABRICATION

- A. Configuration: Forced draft.
- B. Configuration: Induced draft.
- C. Casing: Galvanized steel complying with ASTM A 653/A 653M, G210 coating designation.
- D. Collecting Basin: Galvanized steel complying with ASTM A 653/A 653M, G210 coating designation.
 - 1. Removable strainer with openings smaller than nozzle orifices.
 - 2. Overflow connection.
 - 3. Makeup water connection.
 - 4. Waste water bleed line with valve.
 - 5. Drain Connection: Oversized for use with remote sump.
 - 6. Drain Connection: Side.
 - 7. Drain Connection: Bottom.

2.4 VIBRATION ISOLATORS

- A. Vibration Isolators: Direct isolation (no base) and rubber mounts, minimum deflection of 0.25 inch.
- B. Vibration Isolators: Direct isolation (no base) and restrained-spring isolators, minimum deflection of 0.75 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine proposed route of moving fluid coolers into place and verify that it is free of interferences.
- B. Examine elements and surfaces to support fluid coolers.
- C. Verify piping and wiring roughing-in locations.
- D. Verify suitability of branch-circuit wiring.

3.2 INSTALLATION

- A. Install fluid coolers according to manufacturer's written instructions.
- B. Install and anchor fluid coolers level and plumb, and fasten to supporting structure with vibration isolators and seismic restraints.
- C. Maintain recommended clearances for service and maintenance.
- D. Install grade-mounted fluid coolers on reinforced-concrete bases. Concrete, formwork, and reinforcement are specified in Division 3.
- E. Install fluid coolers and their support structures to withstand the effects of seismic events according to authorities having jurisdiction.
- F. Electrical Wiring: Install electrical devices furnished by fluid cooler manufacturer that are not factory mounted.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
 - 1. Install piping adjacent to fluid coolers to allow service and maintenance.
 - 2. Install flexible pipe connections for coolers mounted on vibration isolators.
 - 3. Pitch piping down to drain into sump.
 - 4. Connect overflow drain and bleed lines to sanitary sewage system.
 - 5. Domestic Water Piping: Comply with applicable requirements of Division 15 Section "Water Distribution Piping." Connect to water-level control with shutoff valve and union or flange at each connection.

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6. Condenser-Water Piping: Comply with applicable requirements of Division 15 Section "Hydronic Piping." Connect to supply and return fluid-cooler connections with shutoff valve, flow control valve, and union or flange on supply connection to the cooler and shutoff valve and union or flange to return connection from the cooler to the chiller.

B. Electrical: Comply with applicable requirements in Division 26 Sections.

C. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

3.5 ADJUSTING

- A. Set and balance condenser-water flow to each fluid-cooler inlet.
- B. Adjust water-level control for proper operating level.

3.6 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.

3.7 COMMISSIONING

- A. Complete installation and startup checks according to manufacturer's written instructions and do the following:
 1. Clean entire unit and wash the basin.
 2. Ensure accessories are properly installed.
 3. Check makeup water float.
 4. Check clearances for airflow and for fluid-cooler servicing.
 5. Check for vibration isolation and structural support.
- B. Obtain wet-bulb, cooler-size, and performance selection tables from manufacturer.
- C. Lubricate bearings on fans and shaft as recommended by manufacturer.

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- D. Ensure fan wheels rotate in correct direction without vibration or binding.
- E. Adjust belts to proper alignment and tension.
- F. Start fluid-cooler and condenser-water pumps. Follow manufacturers written starting procedures.
- G. Check water level in fluid-cooler basin.
- H. Check operation of fluid-cooler basin, makeup line, and controlling devices.
- I. Check operation of basin immersion heater and control thermostat.
- J. Ensure system chemical treatment is working, and measure chemical treatment levels. Check operation of fluid-cooler basin automatic blow-down, and controlling device.
- K. Verify that fluid-cooler discharge is not recirculating into air intakes.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
 - 1. Train Owner's maintenance personnel on procedures and schedules for starting up and shutting down, troubleshooting, servicing, and maintaining fluid coolers.
 - 2. Review data in maintenance manuals. Refer to Division 1.
 - 3. Review data in maintenance manuals. Refer to Division 1.

END OF SECTION 23 65 00

SECTION 23 72 00 - AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Packaged Energy Recovery Units – Fixed Plate Enthalpic

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, furnished specialties, and accessories.
- B. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- C. Wiring Diagrams: For power, signal, and control wiring.
- D. Operation and Maintenance Data: For air-to-air energy recovery equipment to include in 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. ARI Compliance: Capacity ratings for air-to-air energy recovery equipment shall comply with ARI 1060, "Rating Air-to-Air Energy Recovery Equipment."
- C. ASHRAE Compliance:
 - 1. Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
 - 2. Capacity ratings for air-to-air energy recovery equipment shall comply with ASHRAE 84, "Method of Testing Air-to-Air Heat Exchangers."
- D. UL Compliance: UL 1812.

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1.5 COORDINATION

- A. Coordinate layout and installation of air-to-air energy recovery equipment and suspension system with other construction that penetrates ceilings or is supported by them.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 PACKAGED ENERGY RECOVERY UNITS – FIXED PLATE ENTHALPIC

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. RenewAire LLC.
 - 2. Mitsubishi Electric Sales Canada Inc.
- B. Quality Assurance
 - 1. The energy recovery cores used in these products shall be third party Certified by AHRI under its Standard 1060 for Energy Recovery Ventilators. AHRI published certifications shall confirm manufacture's published performance for airflow, static pressure, temperature and total effectiveness, purge air (OACF) and exhaust air leakage (EATR). Products that are not currently AHRI Certified will not be accepted.
 - 2. Manufacturer shall be able to provide evidence of independent testing of the core by Underwriters Laboratory (UL), verifying a maximum flame spread index (FSI) of 25 and a maximum smoke developed index (SDI) of 50 thereby meeting NFPA 90A and NFPA 90B requirements for materials in a compartment handling air intended for circulation through a duct system. The method of test shall be UL Standard 723.
 - 3. Unit shall be Listed under UL 1812 Standard for Ducted Air to Air Heat Exchangers. Some exceptions to UL Listing may apply. Units intended for "Outdoor Use" shall be listed using the specific UL requirements for rain penetration, corrosion protection and seal durability and shall be so labeled.
 - 4. The ERV core shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of ten years from the date of purchase. The balance-of-unit shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of two years from the date of purchase.
- C. Performance
 - 1. Energy Transfer: The ERV shall be capable of transferring both sensible and latent energy between airstreams. Latent energy transfer shall be accomplished by direct water

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vapor transfer from one air stream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air.

2. Passive Frost Control: The ERV core shall perform without condensing or frosting under normal operating conditions (defined as outside temperatures above -10°F and inside relative humidity below 40%). Occasional more extreme conditions shall not affect the usual function, performance or durability of the core. No condensate drains will be allowed.
3. Continuous Ventilation: Unit shall have the capacity to operate continuously without the need for bypass, recirculation, pre-heaters, or defrost cycles under normal operating conditions.
4. Positive Airstream Separation: Water vapor transfer shall be through molecular transport by hygroscopic resin and shall not be accomplished by “porous plate” mechanisms. Exhaust and fresh airstreams shall travel at all times in separate passages, and airstreams shall not mix.
5. Laminar Flow: Airflow through the ERV core shall be laminar over the products entire operating airflow range, avoiding deposition of particulates on the interior of the energy exchange plate material.

D. Construction

1. The energy recovery component shall be of fixed-plate cross-flow construction, with no moving parts.
2. No condensate drain pans or drains shall be allowed and unit shall be capable of operating in both winter and summer conditions without generating condensate.
3. The unit case shall be constructed of G90 galvanized, 20-gauge steel, with lapped corners and zinc plated screw fasteners. The unit roof shall be one piece or have watertight standing seam joints and shall overlap wall panels and doors in order to positively shed water.
4. Access doors shall provide easy access to blowers, ERV cores, and filters. Doors shall have an airtight compression seal using closed cell foam gaskets rated for outdoor exposure. Pressure taps, with captive plugs, shall be provided allowing cross-core pressure measurement allowing for accurate airflow measurement.
5. Weather hoods shall be screened to exclude birds and animals. Inlet weather hoods shall be sized to maintain inlet velocities below 500 fpm, and equipped with rain excluder baffles.
6. Case walls and doors shall be insulated with 1 inch, 4 pound density, foil/scrim faced, high-density fiberglass board insulation, providing a cleanable surface and eliminating the possibility of exposing the fresh air to glass fibers, and with minimum R-value of 4.3 (hr·ft²·°F/BTU).
7. The ERV cores shall be protected by a MERV-8 rated, 2” nominal, pleated, disposable filter in both airstreams.
8. Unit shall have single-point power connection and a single-point 24 VAC contactor control connection
9. Blower motors shall be Premium Efficiency, EISA compliant for energy efficiency. The blower motors shall be totally enclosed (TEFC) and shall be supplied with factory installed motor starters (HE6X and HE8X 208-230/460V models are open drip proof). Direct drive models (EV450 and HE1X models) shall be EISA compliant for energy efficiency with open drip proof design and integral thermal protection.

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10. Blowers shall be quiet running, forward curve type and be direct drive (EV450 and HE1X only)
11. The unit electrical box shall include a factory installed, non-fused disconnect switch and a 24 VAC, Class II transformer/relay package.
12. The ERV shall be provided “inverter-ready” allowing for applications of inverters supplied and installed by others

E. Options

1. Provide unit and duct connection orientation per project schedule.
2. Provide double wall construction with 24-gauge galvanized steel liner.
3. Provide factory installed disconnect fuses.
4. Provide factory installed filter monitors for each airstream.
5. Provide ECM controlled motors (available for EV450IN and HE1XIN models) allowing for to preset speeds or variable speed operation with a 0-10 volt DC control signal.
6. Provide factory installed isolation dampers for either or both air streams (available for all models except EV450IN). The insulated dampers shall be of a low leakage design and shall not restrict the airstream, reducing airflow, in any way. The dampers shall be opened with a motor actuator powered by the standard unit transformer package and have a spring return for low off- position power consumption.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine casing insulation materials and filter media before air-to-air energy recovery equipment installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.
- E. Locate and orient unit to provide the shortest and most straight duct connections. Provide service clearances as indicated on the plans. Locate units distant from sound critical occupancies.

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3.2 INSTALLATION

- A. Install units with clearances for service and maintenance.
- B. Equipment Mounting: Install floor-mounted air-to-air energy recovery equipment on concrete bases. Comply with requirements for concrete bases specified in Section 23 05 00 "Common Work Results for HVAC".
- C. Suspended Units: Suspend and brace units from structural-steel support frame using threaded steel rods and spring hangers. Comply with requirements for vibration isolation devices specified in Division 23 Section vibration/seismic specification section.
- D. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.
- E. Sound Control: To control sound associated with the two blower outlets:
 - 1. Provide straight, gradual transition ductwork for a minimum of 2-1/2 duct diameters downstream from the blower outlet.
 - 2. Provide continuous acoustic insulation treatment of the duct until after the first elbow or tee.

3.3 CONNECTIONS

- A. Comply with requirements for piping specified in Division 23 Section "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Comply with requirements for ductwork specified in Division 23 Section "Ductwork."
- C. Install piping adjacent to machine to allow service and maintenance.

3.4 FIELD QUALITY CONTROL

- A. Test and Balancing: Test and Balancing may not begin until 100% of the installation is complete and fully functional.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Tests and Inspections:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

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2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 3. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- D. Air-to-air energy recovery equipment will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy recovery units.

END OF SECTION 23 72 00

SECTION 23 81 29 - WATER-COOLED VARIABLE REFRIGERANT FLOW SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Division 23 Section "Common Work Results for HVAC"

1.2 SUMMARY

- A. This Section includes a variable refrigerant flow (VRF) system including condensing units, indoor units, accessories, and DDC controls. The water-source unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory.
- B. The intent is that the system will provide expansion and direct interface with the existing Daikin VRF Heat Recovery Heat Pump system currently in place at the facility.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.
- C. Qualification: Submit evidence that the installing contractor shall have been certified by the manufacturer to install VRF systems, having attended a minimum 3- day VRF Service & Installation course at an approved training center. A copy of this certificate shall be presented as part of the VRF equipment submittal process. It is the contractor's responsibility to sign up and take this class before installation begins.
- D. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label.
- B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).

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- C. All units must meet or exceed the 2010 Federal minimum efficiency requirements and the ASHRAE 90.1 efficiency requirements for VRF systems. Efficiency shall be published in accordance with the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 1230.
- D. A full charge of R-410A for the condensing unit only shall be provided in the condensing unit.
- E. Units shall be stored and handled according to the manufacturer's recommendation.

1.5 WARRANTY

- A. The equipment shall be provided with the following warranty per the VRF manufacturer's warranty policy:
 - 1. Compressor: 7-year part only
 - 2. Parts: 5-years part only

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Daikin (Basis of Design)
 - 2. Mitsubishi
 - 3. Trane
- B. Although alternate manufacturers to the basis of design will be considered, it shall be a requirement that the alternate products meet all specified requirements and interface seamlessly with both the Siemens Apogee BAS and the existing Daikin VRF Heat Pump Heat Recovery System, to the extent necessary for operation as specified.

2.2 WATER-COOLED CONDENSING UNIT

- A. General: The condensing unit is designed specifically for use with VRV-WIII series components.
 - 1. The condensing unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of Daikin scroll compressors, motors, brazed plate heat exchanger, electronic expansion

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valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and liquid receivers.

2. Discharge pressure gas line, liquid and suction lines must be individually insulated between the condensing and indoor units.
3. System shall have an operable flow rate range of 13.2–40.0 gpm per module for standard operation.
4. System shall have an operating inlet water temperature range of 50°F-113°F for standard operation. The system will automatically restart operation after a power failure and will not cause any settings to be lost.
5. Each condensing unit shall have a 240VAC, 0.3mA-0.5A control circuit output for water pump or isolation valve operation. This circuit shall be configured at commissioning to operate based on system or compressor operation.
6. Each condensing unit shall incorporate normally open, 15VDC and 1.0mA rated contacts for integration of a mandatory flow proving device.
7. Oil recovery cycle shall be automatic occurring 2 hours after start of operation and then every 8 hours of operation.

B. Compressor:

1. The Daikin inverter scroll compressors shall be variable speed (PWM inverter) controlled which is capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit.
2. The capacity control range shall be 8% to 100%.
3. The compressor shall be spring mounted to avoid the transmission of vibration.

C. Electrical:

1. The power supply to the outdoor unit shall be 208 volts, 3 phase, 60 hertz +/- 10%.
2. The control voltage between the indoor and outdoor unit shall be 18VDC non-shielded, stranded 2 conductor cable.
3. The control wiring shall be a two-wire multiplex transmission system.

2.3 BRANCH SELECTOR BOX FOR VRV HEAT RECOVERY SYSTEM

A. General: The branch selector boxes shall be designed specifically for use with the VRV series heat recovery system components.

B. Condensate Removal:

1. The unit shall not require provisions for condensate removal.

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C. Electrical:

1. The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.
2. The unit shall be capable of operation within the limits of 187 volts to 255 volts.
3. The minimum circuit amps (MCA) shall be 0.1 and the maximum overcurrent protection amps (MOP) shall be 15.
4. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded 2 conductor cable.

2.4 CONCEALED CEILING DUCTED UNIT (Med. Static)

A. General:

1. Basin of Design: Daikin indoor unit FXMQ_PB. Unit shall be a built-in ceiling concealed fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, direct-drive DC (ECM) type fan with auto CFM adjustment at commissioning, for installation into the ceiling cavity. Units to be controlled by BRC1E73 programable controllers. Unit's equipped with factory condensate drain pan and drain pump kit and has a built in safety shutoff and alarm. Pumps to 18-3/8" from the drain pipe opening. All refrigerant lines shall be individually insulated from the outdoor unit.
2. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 18-3/8" of lift from the center of the drain outlet and has a built in safety shutoff and alarm.
3. The indoor units shall be equipped with a return air thermistor.
4. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.

B. Coil:

1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The refrigerant connections shall be flare connections and the condensate will be 1-1/4" outside diameter PVC.
3. A condensate pan shall be located under the coil. A thermistor will be located on the liquid and gas line.

C. Electrical:

1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.

D. Control:

1. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.

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2. The Daikin Intelligent Touch Manager with BACnet software shall integrate into the existing Siemens control system.

E. Local Control:

1. The BRC1E73 programable controllers provide control for all VRV indoor units. The remote controller wiring consist of a non-polar two-wire connection to the indoor unit at terminals P1/P2.

F. Filter Box:

1. Furnish and install a Buckley Filter Box specifically manufactured for the heat pump manufacturer. Provide 2" pleated filters, MERV 30. Box shall provide for bottom or side access as required to meet the site constraints for each unit.access.

PART 3 - EXECUTION

3.1 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to unit to allow service and maintenance.
- C. Coordinate locations of indoor units with structure, ceiling grid, and other trades – must maintain heat pump manufacturer's recommended service clearances.
- D. Provide insulated refrigerant piping per heat pump manufacturer's recommendations.
- E. Route indoor unit condensate drains to sink traps, floor drains, plumbing code compliant, or other locations as indicated.

3.2 WIRING

- A. Electrical Connections: Comply with requirements in Electrical Specification Sections for power wiring, switches, and motor controls.
- B. All electrical control wiring to the control panels shall be the responsibility of the Installing Contractor.

3.3 VRF SYSTEM COMMISSIONING

A. General

1. All VRF System Commissioning activities shall be completed by an employee of the VRF manufacturer whose primary job responsibilities are to provide start up and commissioning of their products; sales staff or in-house support staffs are not permitted to complete this scope of work.
2. The installing contractor shall have been certified by the manufacturer to install VRF systems, having attended a minimum 3- day VRF Service & Installation course at an approved training center. A copy of this certificate shall be presented as part of the VRF equipment submittal process. It is the contractor's responsibility to sign up and take this class before installation begins.
3. Upon completion of the Equipment installation and before start up the contractor shall test piping per manufacturer's instructions and pull refrigerant piping into a 500 micron vacuum. System shall hold this vacuum for no less than 24 hours. The VRF manufacturer shall provide a formal report outlining the status of the system, in electronic format only. Contained within this report shall be copies of all field inspection reports, required action items and status, Manufacturers design software, equipment model & serial numbers.
4. Completion of the Equipment Start-Up and VRF Commissioning process shall verify that the VRF system has been installed per the Engineer's design intent and complies with the VRF manufacturers engineering and installation specifications related to their equipment.
5. Compliance with federal, state and local codes as well as other authorities having jurisdictions are not part of this process and are the responsibility of the installing contractor.
6. Upon the completion of the 500-micron hold, the calculated additional refrigerant charge can be added. Contractor shall keep track of total liquid line piping lengths for each system. The calculated refrigerant charge shall have been calculated using the VRF manufacturers design software.
 - a. Total refrigerant charge of the system shall be recorded and displayed at the condensing unit by permanent means.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.
- B. The VRF manufacturer shall provide the owner's representative a minimum 4-hour VRF Operation and Maintenance training class covering systems installed under this scope of work.
- C. Training program is to be provided at the time of owner occupancy.

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- D. Owner shall provide a suitable location, onsite, to conduct the VRF Operation and Maintenance class.

END OF SECTION 23 81 29

SECTION 26 10 00 - BASIC ELECTRICAL REQUIREMENTS

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. Alternates: Refer to Division 01 to determine extent of, if any, work of this section that will be affected by any alternates if accepted.
- B. Furnish all materials, equipment, labor, and supplies and perform all operations necessary to complete the electrical work in accordance with the intent of the drawings and these specifications.

1.3 QUALITY ASSURANCE

- A. All wiring shall be in accordance with the latest issue of the National Electrical Code.
- B. The Contractor shall show evidence, upon request, of having successfully completed at least five similar projects. Installation of each system shall be under the supervision of a factory-authorized organization.
- C. The Contractor shall show evidence, upon request, that he maintains a fully equipped service organization capable of furnishing adequate inspection and service to the system. The Contractor must have a service contract program for the maintenance of the system after the guarantee period.
- D. All electrical equipment shall be listed by Underwriters Laboratories, Inc. Each system shall be products of a single manufacturer of established reputation and experience. The Contractor shall have supplied similar apparatus to comparable installations rendering satisfactory service for at least three years.
- E. Prior to submission for review of any item of equipment, determine whether or not it will fit in the space provided. Any changes in the size or location of the material or equipment supplied, which may be necessary in order to meet field conditions or in order to avoid conflicts between trades, shall be brought to the immediate attention of the Architect/Engineer and approval received before such alterations are made.

1.4 SUBMITTALS

- A. In accordance with Division 01, furnish the following:
1. Manufacturer's descriptive literature: For each type of product indicated.
 2. Submit shop drawings which include engineering drawings of the system with specification sheets covering all component parts of the system and interconnection diagrams.
 3. Certification:
 - a. Prior to final inspection, deliver to the Owner's Representative certification that the material is in accordance with the drawings and specifications and has been properly installed.
 - b. Submit certification of system operating test.
 4. Manuals: Submit copies of complete set of operating instructions including circuit diagrams and other information of system components.

1.5 PROJECT CONDITIONS

- A. Regulatory Requirements:
1. Conform to the requirements of all laws and regulations applicable to the work.
 2. Cooperate with all authorities having jurisdiction.
 3. Compliance with laws and regulations governing the work on this project does not relieve the Contractor from compliance with more restrictive requirements contained in these specifications.
 4. If the Contract Documents are found to be at variance with any law or regulation, the Contractor shall notify the Architect/Engineer promptly in writing. The Contractor shall assume full responsibility for any work contrary to law or regulation, and shall bear all costs for the corrections thereof.
 5. Minimum Requirements: The National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL), the National Fire Codes, and National Fire Protection Association (NFPA) are a minimum requirement for work under this section. Design drawings and other specification sections shall govern in those instances where requirements are greater than those required by code.
- B. Permits, Fees, and Inspections:
1. Secure and pay for all permits, fees, licenses, inspections, etc., required for the work under Division 26.
 2. Schedule and pay for all legally required inspections and cooperate with inspecting officers.
 3. Provide Certificates of Inspection and Approval from all regulatory authorities having jurisdiction over the work in Division 26.

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C. Drawings:

1. Do not scale the drawings. The general location of the apparatus and the details of the work are shown on the drawings, which form a part of this specification. Exact locations are to be determined at the building as the work progresses, and shall be subject to the Architect/Engineer's approval. Actual field conditions shall govern all dimensions.
2. Anything shown on the drawings and not mentioned in the specifications or vice versa shall be provided as if it were both shown and specified.
3. It is not intended that the drawings shall show every wire, device, fitting, conduit or appliance, but it shall be a requirement to furnish without additional expense, all material and labor necessary to complete the systems in accordance with applicable codes and the best practice of the trade.

1.6 WARRANTY

- A. The Contractor shall guarantee all equipment and wiring free from inherent mechanical or electrical defects for one year from date of acceptance.

1.7 RELATED WORK

- A. Division 23 - Mechanical

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Receptacles shall be specification grade, mounted 18" above finished floor unless otherwise noted.
- B. Duplex Receptacles with Ground-Fault Interrupter shall be an integral unit suitable for mounting in a standard outlet box.
 1. Ground-Fault Interrupter shall consist of a differential current transformer, solid state sensing circuitry and a circuit interrupter switch. It shall be rated for operation on a 60 Hz, 120-volt, 20-ampere branch circuit. Device shall have nominal sensitivity to ground leakage current of five milliamperes and shall function to interrupt the current supply for any value of ground leakage current above five milliamperes on the load side of the device. Device shall have a minimum nominal tripping time of 1/30th of a second.
 2. Receptacle shall be rated 20 amperes, 125 volts for outdoor use and shall be the standard duplex, three-wire, grounding type.
- C. Weatherproof Receptacles shall consist of a duplex GFI receptacle, as specified, mounted in a weatherproof box with a gasketed, weatherproof, cast metal cover plate. The weatherproof integrity shall not be affected when heavy duty specification or hospital grade attachment plug

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caps are inserted. Cover plates on outlet boxes mounted flush in the wall shall be gasketed to the wall in a watertight manner.

- D. Plates shall be 302 stainless steel.
- E. Boxes shall be steel minimum 2-1/2" deep.
- F. Disconnect Switches shall be heavy-duty type, horsepower rated.
- G. Wiring Materials:
 - 1. Wiring shall be enclosed in electrical rigid galvanized steel, intermediate metal conduit, or electrical metallic tubing sized in accordance with code requirements for the conductors. Type MC cable may be used where concealed in walls or ceilings and allowed by code.
 - a. Conduit fittings shall be steel. Provide set-screw type in dry locations and compression type in damp or wet locations.
 - b. Terminations for all conduit shall have insulated bushings or insulated throat connectors in accordance with code requirements.
 - c. All conduits shall be substantially supported with approved clips or hangers spaced not to exceed ten feet on center. Minimum conduit size shall be 1/2".
 - 2. Surface Metal Raceway: UL 5 listed.
 - a. Boxes and fittings for surface metal raceways shall be as recommended by the manufacturer.
 - b. Support clips for surface metal raceways shall be the concealed type, with attachment screws concealed behind the raceway.
 - 3. Flexible Metal Conduit shall be used for all connections to motors and vibrating equipment and shall comply with Fed. Spec. WW-C-566.
 - 4. Liquid-Tight Flexible Metal Conduit shall consist of flexible steel conduit with a liquid-tight PVC jacket over the conduit.
 - a. Fittings shall incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening.
 - b. Liquid-tight flexible metal conduit shall be used in damp or wet locations when flexible metal conduit would otherwise be used.
 - c. Liquid-tight flexible metal conduit shall not penetrate the roof or exterior walls, and shall not be installed in lengths exceeding 72" except where necessary for flexibility.
 - 5. All Wiring shall be type THW, XHHW, or THWN, UL labeled, copper conductors with 600-volt insulation, except as otherwise noted. Minimum size wire shall be No. 12 AWG.
 - 6. Type MC Cable shall have minimum No. 12 AWG type THWN or XHHW insulated copper conductors with an internal bare or insulated copper ground wire.

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H. Fire-Stop Material:

1. Fire-stopping material shall maintain its dimension and integrity while preventing the passage of flame, smoke, and gases under conditions of installation and use when exposed to the ASTM E 119 time-temperature curve for a time period equivalent to the rating of the assembly penetrated. Cotton waste shall not ignite when placed in contact with the non-fire side during the test. Fire-stopping material shall be noncombustible as defined by ASTM E 136; and in addition for insulation materials, melt point shall be a minimum of 1700°F for one-hour protection and 1850°F for two-hour protection.
2. Seals for floor, exterior wall, and roof shall also be watertight.

I. Panelboards:

1. Provide standard manufacturer products. All components of panelboards shall be the product and assembly of the same manufacturer. All similar units of all panelboards shall be of the same manufacturer.
2. All panels shall be dead front safety type.
3. All panelboards shall be completely factory assembled with molded case circuit breakers.
4. Panels shall have main breaker or main lugs, bus size, voltage, phase, and flush or surface mounting all as scheduled on the drawings. Panelboards to be used as service equipment shall be listed for such use.
5. Panelboards shall have the following features:
 - a. Non-reduced size copper or aluminum bus bars and connection straps bolted together and rigidly supported on molded insulators. Bus bar taps shall be arranged for sequence phasing of branch circuit devices.
 - b. Full size neutral bar mounted on insulated supports.
 - c. Ground bar with sufficient terminals for all grounding wires. The ground bar shall be insulated and isolated where called for on the drawings.
 - d. Buses braced for the available short-circuit current, but not less than scheduled and never less than 10,000 amperes symmetrical. All panelboards shall be fully rated. Series rated assemblies are not acceptable.
 - e. All breakers arranged so that it will be possible to substitute a two-pole breaker for two single pole breakers or a three-pole breaker for three single pole breakers when frame size is 100 amperes or less.
 - f. Design interior so that protective devices can be replaced without removing adjacent units, main bus connectors and without drilling or tapping.
 - g. Where designated, on panel schedule as "space", include all necessary bussing, device supports and connections. Provide blank cover for each space.
 - h. Provide galvanized steel cabinets to house panelboards. Cabinets for panelboards may be factory primed and suitably treated with a corrosion-resisting paint finish meeting UL standard for outdoor applications.
 - i. Back and sides shall be of one-piece formed steel. Cabinets for panelboards may be of formed sheet steel with end and side panels welded, riveted or bolted as required.
 - j. Provide minimum of four interior mounted studs and necessary hardware for in and out adjustment of panel interior.

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- k. Fabricate trim of sheet steel consisting of frame with door attached by concealed hinges. Provide flush or surface trim as shown on the drawings.
 - l. Surface trim shall have the same width and height as the box.
 - m. Provide doors with flush type latch and manufacturer's standard lock.
 - n. In making switching devices accessible, doors shall not uncover any live parts.
 - o. Provide concealed butt hinges welded to the doors and trims.
 - p. Provide keyed alike system for all panelboards.
 - q. Provide a directory card, metal holder, and transparent cover. Permanently mount holders on inside of doors.
- J. Circuit breakers in panelboards shall be bolt on type on phase bus bar or branch circuit bar. Molded case circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips.
- K. Circuit Breakers: Circuit breakers to be added to existing panelboards shall match existing circuit breakers.
- L. Grounding Conductors:
- 1. Grounding conductors shall be soft-drawn bare copper.
 - 2. Insulated grounding wires shall be UL and NEC approved types, copper, with THWN or XHHW insulation color identified green, except where otherwise shown on the drawings or specified.
 - 3. Wire shall not be less than shown on the drawings and not less than required by the NEC.
- M. Equipment Grounding Connections: Connections shall be of the compression type solderless connectors.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
- 1. All work shall be in accordance with the National Electrical Code's requirements as amended to date, with the local electric utility company's rules, the Fire Underwriter's requirements, and all local, state and federal laws and regulations.
 - 2. In general, all wiring in finished areas shall be concealed in walls or above ceilings. Where wiring cannot be concealed due to existing construction, exposed wiring shall be installed in conduit or surface metal raceway as directed by the Engineer. Exposed wiring shall not be installed in finished areas without prior written authorization from the Engineer.
 - 3. Conduits shall be of sizes required by the National Electrical Code. Exposed conduits shall be installed with runs parallel or perpendicular to walls and ceiling, with right-angle turns consisting of bends, fittings, or outlet boxes. No wire shall be installed until work

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- that might cause damage to wires or conduits has been completed. Conduits shall be thoroughly cleaned of water or other foreign matter before wire is installed.
4. Where conduits, wireways and other electrical raceways pass through fire partitions, fire walls, or floor, install a fire-stop that provides an effective barrier against the spread of fire, smoke and gases. Fire-stop material shall be packed tight and completely fill clearances between raceways and openings. Floor, exterior wall, and roof seals shall also be made watertight.
 5. Where raceways puncture roof, coordinate with Division 07.
 6. Raceway penetrations through roof and exterior walls shall be made with rigid metal conduit, intermediate metal conduit, or EMT with compression fittings.
 7. Surface metal raceways shall be sized as required by the National Electrical code and as recommended by the manufacturer. Surface metal raceways shall be installed with runs parallel or perpendicular to walls and ceiling. Changes in direction shall only be made at device box locations or with fittings designed for the particular application. Installation shall be as visually unobtrusive as possible:
 - a. Surface metal raceways shall be painted to match wall finishes.
 8. All splices shall be mechanically and electrically perfect, using crimp type wire connectors.
 9. Provide all disconnect switches required by the N.E.C.
 10. Locate motor starters as shown on drawings.
 11. Mount disconnect switches and starters at a height of 60" above finished floor unless otherwise noted. Disconnect switches on roof shall be mounted 24" above roof.
 12. Provide all necessary hardware, galvanized slotted steel channel, etc. for mounting disconnect switches.
 13. Locate panelboards so that the present and future conduits can be conveniently connected.
 14. A typewritten schedule of circuits, approved by the Owner's Representative shall be on the panel directory cards. Type the room numbers and items served on the cards. Three-complete separate copies of all directories, neatly bound, shall be delivered to the Owner's Representative.
 15. Revise existing panelboard directories. Furnish new cards as needed. Directories shall be typewritten or printed using a computer.
 16. Mount the panelboard so that maximum height of circuit breakers above finished floor shall not exceed 78".
 17. Circuit numbers indicated on the drawings are the actual numbers assigned to the circuit in the panelboard and shall not be varied without the consent of the Architect/Engineer.
 18. Provide all necessary hardware for mounting panelboards.
 19. Feeder circuit wiring shall be in conduit or EMT.
 20. In general, conductors shall be the same size from the last protective device to the load and shall have an ampacity the same as or greater than the ampacity of the protective device where the wire size is not shown on the drawings. Use the 60°C ampacity rating for wire sizes No. 12 through No. 1. For 120V circuits, home runs longer than 100 feet shall be minimum No. 10 AWG, longer than 200 feet shall be minimum No. 8 AWG.

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B. Grounding:

1. The entire electrical system shall be permanently and effectively grounded in accordance with Code requirements.
2. Connections to junction boxes, equipment frames, etc., shall be bolted.
3. Conduit Systems:
 - a. Ground all metallic conduit systems.
 - b. Conduit systems shall contain a grounding conductor sized per NEC Table 250-122 or as shown on the drawings. Increase conduit size where necessary to accommodate the grounding conductor.
4. Feeders and Branch Circuits: Install green grounding conductors with all feeders and branch circuits.

C. Alterations:

1. The Contractor shall study all drawings and specifications, visit the site, and acquaint himself with the existing conditions and the requirements of the plans and specifications. No claim will be recognized for extra compensation due to the failure of the Contractor to familiarize himself with the conditions and extent of the proposed work.
2. The Contractor shall execute all alterations, additions, removals, relocations or new work, etc., as indicated or required to provide a complete installation in accordance with the intent of the drawing and specifications.
3. Reconnect existing circuits to remain. Remove existing equipment to be discontinued.
4. Any existing work disturbed or damaged by the alterations or new work shall be repaired or replaced to the Engineer's satisfaction.
5. Equipment relocated or removed and reinstalled shall be cleaned and repaired to a first-class condition before reinstallation.

D. Continuity of Services: Arrange to execute work at such times and in such locations to provide uninterrupted service to the building or any of its sections. If necessary, temporary power shall be installed to provide for this condition. Authorization for interrupting service shall be obtained in writing from the Owner. Any interruption of normal supply shall be performed during an overtime period to be scheduled with the Owner. Cost for overtime work shall be included in the bid.

E. Identification:

1. Provide tags on each end of all pulled wires giving location of other end.
2. Provide phenolic nameplates for all panelboards and disconnect switches (except switches located at motors).
3. Label each receptacle faceplate using machine-printed thermal adhesive labels to indicate source panel and branch circuit.

F. Record Drawings: The Contractor shall keep on the job a set of prints showing any changes to the installation. These shall be given to the Engineer at the completion of the work.

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G. Testing and Adjusting:

1. The entire installation shall be free from short-circuits and improper grounds. Tests shall be made in the presence of the Engineer or his representatives.
2. Each individual circuit shall be tested at the panel; and in testing for insulation resistance to ground, the equipment shall be connected for proper operation. In no case shall the insulation resistance be less than that required by the National Electrical Code. Failures shall be corrected in a manner satisfactory to the Architect/Engineer.
3. Each system shall be completely tested and shall be adjusted for proper operation as required by the Engineer.

END OF SECTION 26 10 00

