

Westside High School Cooling Tower & Enclosure

Omaha, Nebraska

**Construction Documents
Project Manual**

Date: October 24, 2025
Project No: 2025.016.00

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Prepared

By

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The following list represents the project team members responsible for preparing individual specification section sections:

TACK.....TACKarchitects
 MEI..... Morrissey Engineering
 TD2.....Thompson Dreessen & Dörner
 PA.....Project Advocates

See drawings for additional specification information.

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PA.....Project Advocates

See drawings for additional specification information.

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PA.....Project Advocates

See drawings for additional specification information.

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The following list represents the project team members responsible for preparing individual specification section sections:

TACK.....TACKarchitects
MEI..... Morrissey Engineering
TD2.....Thompson Dreessen & Dornier
PA.....Project Advocates

See drawings for additional specification information.

SECTION 00 11 16 - INVITATION TO BID

1.1 PROJECT INFORMATION

- A. Notice to Bidders: Bidders are invited to submit bids for Project as described in this Document according to the Instructions to Bidders. Submit bids according to the Instructions to Bidders.
- B. Project Identification: Westside High School Cooling Tower.
 - 1. Project Location: 8701 Pacific Street, Omaha, Nebraska, 68114.
- C. Owner: Westside Community Schools.
 - 1. Owner's Representative: Chris Bilau, Project Advocates, 402-507-0844, chrisb@project-advocates.com
- D. Architect: TACKarchitects, Inc.
- E. Project Description: Project consists of a Fluid Cooler with associated structure, piping, and electrical.
- F. Construction Contract: Bids will be received for the following Work:
 - 1. General Contract (all trades).

1.2 BID SUBMITTAL AND OPENING

- A. Owner will receive sealed bids until the bid time and date at the location indicated below. Owner will consider bids prepared in compliance with the Instructions to Bidders issued by Owner, and delivered as follows:
 - 1. Bid Date: November 20th, 2025.
 - 2. Bid Time: 3:00 PM, local time.
 - 3. Location: Westside Community Schools ABC Building, 909 South 76th Street, Omaha, NE
 - 4. 68114.
 - a. Deliver Bids to; Attn: Chris Bilau.
 - b. Such Bids are to be received in a clearly labeled envelope with the statement "Westside High School Cooling Tower " in Bold and underlined text.
 - c. Bid Opening shall occur in the ABC Building, Boardroom.
 - d. Electronically Submitted Bids are not allowed.
- B. Bids will be thereafter publicly opened and read aloud.

1.3 BID SECURITY

- A. Bid security shall be submitted with each bid in the amount of 5 percent of the bid amount. No bids may be withdrawn for a period of 45 days after opening of bids. Owner reserves the right to reject any and all bids and to waive informalities and irregularities.

1.4 DOCUMENTS

- A. Procurement and Contracting Documents: Documents may be obtained from one of the sources listed below. Cost of Documents will be bidder's responsibility.

1. Project Advocates – Digital Download via OneDrive
2. A&D Technical Supply
3. StandardSHARE

1.5 TIME OF COMPLETION

- A. Successful bidder shall begin the Work on receipt of the Notice to Proceed and shall complete the Work within the Contract Time.
 1. Start Construction – December 15th, 2025
 2. Substantial Completion – July 31st, 2026

1.6 BIDDER'S QUALIFICATIONS

- A. Bidders must be properly licensed under the laws governing their respective trades and be able to obtain insurance and bonds required for the Work. A Performance Bond, separate Labor and Material Payment Bond, and Insurance in a form acceptable to Owner will be required of the successful Bidder.

1.7 NOTIFICATION

- A. This Advertisement for Bids document is issued by Westside Community Schools.

END OF DOCUMENT 00 11 16

DOCUMENT 00 21 13 - INSTRUCTIONS TO BIDDERS

1.1 INSTRUCTIONS TO BIDDERS

- A. AIA Document A701, "Instructions to Bidders," is hereby incorporated into the Procurement and Contracting Requirements by reference.

- 1. A copy of AIA Document A701, "Instructions to Bidders," is bound in this Project Manual.

END OF DOCUMENT 00 21 13

OSCC CONTRACTING COMPANY INFORMATION

Project Westside Communitiy Schools is implementing site access through One Source The Background Check Company (One Source). By using the One Source Certified Contractors program (OSCC), One Source will facilitate account setup and screening prior to individuals gaining site access at the project location.

This program includes a comprehensive criminal history background check along with drug testing if needed. Please see our [OSCC Guidelines](#) for more information on the minimum search criteria and applicant requirements.

A discount code has been assigned to this project for contractors to use in communication with One Source to apply to the account setup fee. The discount code for this project is WCS1167

CONTACT INFORMATION

OSCC Participating Site(s): Westside Communitiy Schools

Level of Screening Required:

☐ Drug Testing Only	☐ Level 2+ (Includes Annual 10-Panel Drug Testing)
☐ Level 1	☐ Level 3
☐ Level 1+ (Included Annual 10-Panel Drug Testing)	☐ Level 3+ (Includes Annual 10-Panel Drug Testing)
☒ Level 2	☒ Badges

Primary Contact Information

Contact Name: _____

Company Name: _____

Email: _____

Phone: _____

Secondary Contact Information

Contact Name: _____

Company Name: _____

Email: _____

Phone: _____

Account Setup Discount Code: WCS1167

Please submit this completed form via email to cr@onesourcebackground.com.

Contact One Source a minimum of two (2) weeks in advance of anticipated project start date to allow for adequate time for account setup and applicant order processing.

SECTION 00 22 13 - SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

1.1 INSTRUCTIONS TO BIDDERS

- A. AIA Document A701, "Instructions to Bidders." is hereby incorporated into the Procurement and Contracting Requirements by reference.
 - 1. A modified copy of AIA Document A701, "Instructions to Bidders," 2018 Edition is bound in this Project Manual.

1.2 ONE SOURCE CERTIFIED CONTRACTORS PROGRAM

- A. All firms and their employees working on-site will be required to obtain One Source Certified Contractors badging and verification in accordance with OSCC policies and Westside Community School requirements. The associated costs shall be included in the bids. Information related to the requirements are included following this Section.

END OF DOCUMENT 00 22 13

SECTION 00 25 13 - PREBID MEETINGS

1.1 PREBID MEETING

- A. Construction Manager will conduct a Prebid meeting as indicated below:
 - 1. Meeting Date: November 6th, 2025
 - 2. Meeting Time: 2:00 P.M.
 - 3. Location: Westside High School-8701 Pacific St, Omaha, Nebraska. Meet outside at the Loading Dock on the South West corner of the High School.
- B. Attendance:
 - 1. General Contractors and Subcontractors: Attendance at Prebid meeting is recommended.
- C. Bidder Questions: Submit written questions to be addressed at Prebid meeting minimum of two business days prior to meeting.
- D. Agenda: Prebid meeting agenda will include review of topics that may affect proper preparation and submittal of bids, including the following:
 - 1. Procurement and Contracting Requirements:
 - a. Advertisement for Bids.
 - b. Instructions to Bidders.
 - c. Bidder Qualifications.
 - d. Bonding.
 - e. Insurance.
 - f. Bid Security.
 - g. Bid Form and Attachments.
 - h. Bid Submittal Requirements.
 - i. Bid Submittal Checklist.
 - j. Notice of Award.
 - 2. Communication during Bidding Period:
 - a. Obtaining documents.
 - b. Access to Project Web site.
 - c. Bidder's Requests for Information.
 - d. Bidder's Substitution Request/Prior Approval Request.
 - e. Addenda.
 - 3. Contracting Requirements:
 - a. Agreement.
 - b. The General Conditions.
 - c. The Supplementary Conditions.
 - d. Other Owner requirements.
 - 4. Construction Documents:
 - a. Scopes of Work.
 - b. Temporary Facilities.

- c. Use of Site.
 - d. Work Restrictions.
 - e. Alternates, Allowances, and Unit Prices.
 - f. Substitutions following award.
 - 5. Separate Contracts:
 - a. Work by Owner.
 - b. Work of Other Contracts.
 - 6. Schedule:
 - a. Project Schedule.
 - b. Contract Time.
 - c. Other Bidder Questions.
 - 7. Site/facility visit or walkthrough.
 - 8. Post-Meeting Addendum.
- E. Minutes: Entity responsible for conducting the meeting will record and distribute meeting minutes to attendees. Minutes of the meeting are issued as Available Information and do not constitute a modification to the Procurement and Contracting Documents. Modifications to the Procurement and Contracting Documents are issued by written Addendum only.
- 1. Sign-in Sheet: Minutes will include list of meeting attendees.

END OF DOCUMENT 00 25 13

SECTION 00 31 32 - GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but are not a warranty of existing conditions. This Document and its attachments are not part of the Contract Documents.
- B. A geotechnical investigation report for Project, prepared by Thompson, Dreessen, & Dorner, Inc. (TD2 Project No. 2421-171), dated September 29, 2025, is available as Appendix 'A' to this specification.

END OF DOCUMENT 00 31 32

DOCUMENT 00 41 13 - BID FORM - STIPULATED SUM (SINGLE-PRIME CONTRACT)

1.1 BID INFORMATION

- A. Bidder: _____.
- B. Project Name: Westside High School Cooling Tower
- C. Project Location: 8701 Pacific Street, Omaha, Nebraska 68114
- D. Owner: Westside Community Schools
- E. Architect: TACKarchitects, Inc..
- F. Architect Project Number: 2025.016.00.

1.2 CERTIFICATIONS AND BASE BID **INCLUDE ALTERNATES ON BID FORM**

- A. Base Bid, Single-Prime (All Trades) Contract: The undersigned Bidder, having carefully examined the Procurement and Contracting Requirements, Conditions of the Contract, Drawings, Specifications, and all subsequent Addenda, as prepared by TACKarchitects, Inc. and Architect's consultants, having visited the site, and being familiar with all conditions and requirements of the Work, hereby agrees to furnish all material, labor, equipment and services, including all scheduled allowances, necessary to complete the construction of the above-named project, according to the requirements of the Procurement and Contracting Documents, for the stipulated sum of:

1. _____ Dollars (\$_____).

1.3 BID GUARANTEE

- A. The undersigned Bidder agrees to execute a contract for this Work in the above amount and to furnish surety as specified within 10 days after a written Notice of Award, if offered within 60 days after receipt of bids, and on failure to do so agrees to forfeit to Owner the attached bid bond, as liquidated damages for such failure, in the following amount constituting five percent (5%) of the Base Bid amount above:

1. _____ Dollars (\$_____).

- B. In the event Owner does not offer Notice of Award within the time limits stated above, Owner will return to the undersigned the bid bond.

1.4 TIME OF COMPLETION

- A. The undersigned Bidder proposes and agrees hereby to commence the Work of the Contract Documents on a date specified in a written Notice to Proceed to be issued by Architect and shall fully complete the Work within the contract time.
 - 1. On-Site Construction may commence beginning Monday, December 15th, 2025.
 - 2. Substantial Completion no later than Friday July 31st, 2026.

1.5 ACKNOWLEDGMENT OF ADDENDA

A. The undersigned Bidder acknowledges receipt of and use of the following Addenda in the preparation of this Bid:

1. Addendum No. 1, dated _____.
2. Addendum No. 2, dated _____.
3. Addendum No. 3, dated _____.
4. Addendum No. 4, dated _____.

1.6 BID SUPPLEMENTS

A. The following supplements are a part of this Bid Form and are attached hereto.

1. Bid Form Supplement - Bid Bond Form (AIA Document A310-2010).

1.7 CONTRACTOR'S LICENSE

A. The undersigned further states that it is a duly licensed contractor, for the type of work proposed, in City of Omaha and the State of Nebraska, and that all fees, permits, etc., pursuant to submitting this proposal have been paid in full.

1.8 SUBMISSION OF BID

- A. Respectfully submitted this ____ day of _____, 2025.
- B. Submitted By: _____ (Name of bidding firm or corporation).
- C. Authorized Signature: _____ (Handwritten signature).
- D. Signed By: _____ (Type or print name).
- E. Title: _____ (Owner/Partner/President/Vice President).
- F. Witnessed By: _____ (Handwritten signature).
- G. Attest: _____ (Handwritten signature).
- H. By: _____ (Type or print name).
- I. Title: _____ (Corporate Secretary or Assistant Secretary).
- J. Street Address: _____.
- K. City, State, Zip: _____.
- L. Phone: _____.
- M. License No.: _____.
- N. Federal ID No.: _____ (Affix Corporate Seal Here).

END OF DOCUMENT 00 41 13

DOCUMENT 00 43 13 - BID SECURITY FORMS

1.1 BID FORM SUPPLEMENT

- A. A completed bid bond form is required to be attached to the Bid Form.

1.2 BID BOND FORM

- A. AIA Document A312-2010 "Bid Bond" is the recommended form for a bid bond. A bid bond acceptable to Owner, or other bid security as described in the Instructions to Bidders, is required to be attached to the Bid Form as a supplement.
- B. Copies of AIA standard forms may be obtained from The American Institute of Architects; <https://www.aiacontracts.org/>; email: docspurchases@aia.org; (800) 942-7732.

END OF DOCUMENT 00 43 13

SECTION 00 60 00 - PROJECT FORMS

1.1 FORM OF AGREEMENT AND GENERAL CONDITIONS

- A. The following form of Owner/Contractor Agreement and form of the General Conditions shall be used for Project:
 - 1. AIA Document A101-2017 "Standard Form of Agreement between Owner and Contractor Where the Basis of Payment is a Stipulated Sum."
 - a. The General Conditions for Project are AIA Document A201-2017 "General Conditions of the Contract for Construction."
 - 2. The General Conditions are included in the Project Manual.
 - 3. The Supplementary Conditions for Project are incorporated into a modified copy of the General Conditions included in the Project Manual.
 - 4. Owner's document(s) bound following this Document.

1.2 ADMINISTRATIVE FORMS

- A. Administrative Forms: Additional administrative forms are specified in Division 01 General Requirements.
- B. Copies of AIA standard forms may be obtained from the American Institute of Architects; www.aiacontractdocsaiacontracts.org; (800) 942-7732.
- C. Preconstruction Forms:
 - 1. Form of Performance Bond and Labor and Material Bond: AIA Document A312-2010 "Performance Bond and Payment Bond."
 - 2. Form of Certificate of Insurance: AIA Document G715-2017 "Supplemental Attachment for ACORD Certificate of Insurance 25."
- D. Information and Modification Forms:
 - 1. Form for Requests for Information (RFIs): AIA Document G716-2004 "Request for Information (RFI)."
 - 2. Change Order Form: AIA Document G701-2017 "Change Order."
 - 3. Form of Architect's Memorandum for Minor Changes in the Work: AIA Document G710-2017 "Architect's Supplemental Instructions."
 - 4. Form of Change Directive: AIA Document G714-2017 "Construction Change Directive."
- E. Payment Forms:
 - 1. Schedule of Values Form: AIA Document G703-1992 "Continuation Sheet."
 - 2. Payment Application: AIA Document G702-1992/703-1992 "Application and Certificate for Payment and Continuation Sheet."
 - 3. Form of Contractor's Affidavit: AIA Document G706-1994 "Contractor's Affidavit of Payment of Debts and Claims."
 - 4. Form of Affidavit of Release of Liens: AIA Document G706A-1994 "Contractor's Affidavit of Payment of Release of Liens."
 - 5. Form of Consent of Surety: AIA Document G707-1994 "Consent of Surety to Final Payment."

END OF SECTION 00 60 00

DRAFT AIA® Document A101® – 2017

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 « Two thousand twenty five »
(In words, indicate day, month and year.)

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

Douglas County School District 28-0066 a/k/a Westside Community Schools,
A political subdivision of the State of Nebraska
909 South 76th Street
Omaha, NE 68114-4599
Telephone Number: (402) 390-2100, hereinafter referred to as "Owner". «-»«-»
«-»
«-»
«-»

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

«-»«-»
«-»
«-»
«-»

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

«-»
Westside High School Fluid Cooler Project:
• Project Location: Westside High School 8701 Pacific Street Omaha, Nebraska;
• Project Description: Install Owner supplied fluid cooler in an owner provided precast enclosure. Westside High School to remain occupied during construction.
[Hereinafter referred to as "the Project"].»-»
«-»
«-»

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

«-»
TACK Architects, Inc. »«-»
2922 North 61st Street, Studio 1
Omaha, NE 68104«-»
«-»
«-»
«-»

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.

The parties should complete A101®-2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement. AIA Document A201®-2017, 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.



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EXHIBIT A INSURANCE AND BONDS

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. To the extent of any direct conflict or inconsistency between any of the Contract Documents, the Contractor shall immediately seek clarification from the Architect and notify the Owner that clarification has been requested. In the event that the Architect fails to clarify such discrepancy within a reasonable time under the circumstances, the Contractor shall proceed with the Work and give precedence to the Contract Documents in the following order of priority:

- .1 Modifications issued after execution of the Agreement;
- .2 Addenda or Riders issued prior to or in conjunction with the execution of the Agreement, with the Addenda or Riders bearing the latest date taking precedence;
- .3 This Agreement;
- .4 The supplementary conditions;
- .5 The General Conditions of the Contract for Construction;
- .6 The Drawings and Specifications; and
- .7 The Schedule of Contractor's Qualifications, Clarifications, and Assumptions, if any.

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:

(Check one of the following boxes.)

- ☒ [X] The date of this Agreement.
- ☐ [] A date set forth in a notice to proceed issued by the Owner.
- ☐ [] Established as follows:

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User Notes:

(1131376757)

(Insert a date or a means to determine the date of commencement of the Work.)

« »

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

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

§ 3.3 Substantial Completion

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve Substantial Completion of the entire Work:

(Check one of the following boxes and complete the necessary information.)

[« »] Not later than « » (« ») calendar days from the date of commencement of the Work.

[« X »] By the following date: « July 31, 2026 »

§ 3.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work are to be completed prior to Substantial Completion of the entire Work, the Contractor shall achieve Substantial Completion of such portions by the following dates:

Portion of Work	Substantial Completion Date

§ 3.3.3 If the Contractor fails to achieve Substantial Completion as provided in this Section 3.3, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

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.

§ 4.2 Alternates

§ 4.2.1 Alternates, if any, included in the Contract Sum:

Item	Price
None	

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.

(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

Item	Price	Conditions for Acceptance
None		

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

(Identify each allowance.)

Item	Price
None	

§ 4.4 Unit prices, if any:

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

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Item	Units and Limitations	Price per Unit (\$0.00)
None		

§ 4.5 Liquidated damages, if any:
(Insert terms and conditions for liquidated damages, if any.)

« →

§ 4.6 Other:
(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)

« »

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

The Construction Manager shall submit monthly Applications for Payment to both the Architect and Program Manager, if applicable, on AIA Form G702-1992 for approval. Continuation sheets shall be submitted on AIA Form G703-1992. If the Architect and Program Manager approve the application, then they shall submit a Certificate for Payment to the Owner. The Architect and Program Manager may require any additional information deemed necessary and appropriate to substantiate the Application for Payment. Materials that are verified to be on the jobsite or other approved location for use in the Project may also be incorporated into the Application for Payment. The Architect and Program Manager shall have seven (7) days from date of receipt from the Construction Manager of an Application for Payment to approve or reject all or any part of the Application for Payment. The Owner shall pay the undisputed amounts certified by the Architect and Program Manager to the Construction Manager within thirty (30) days of receipt of the Certificate for Payment from the Architect and Program Manager, unless otherwise provided in the Contract Documents.

Provided that an Application for Payment is received by the Architect not later than the « » day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the « » day of the « » month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than « » (« ») 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 of values 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 In accordance with AIA Document A201™-2017, General Conditions of the Contract for Construction, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

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User Notes:

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§ 5.1.6.1 The amount of each progress payment shall first include:

- .1 That portion of the Contract Sum properly allocable to completed Work;
- .2 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; and
- .3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified and that Owner approves.

§ 5.1.6.2 The amount of each progress payment shall then be reduced by:

- .1 The aggregate of any amounts previously paid by the Owner;
- .2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201-2017;
- .3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;
- .4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201-2017; and
- .5 Retainage withheld pursuant to Section 5.1.7.

§ 5.1.7 Retainage

§ 5.1.7.1 For each progress payment made prior to Substantial Completion of the Work, the Owner may withhold the following amount, as retainage, from the payment otherwise due:

(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)

« Ten percent (10%) »

§ 5.1.7.1.1 The following items are not subject to retainage:

(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)

« None »

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

(If the retainage established in Section 5.1.7.1 is to be modified prior to Substantial Completion of the entire Work, including modifications for Substantial Completion of portions of the Work as provided in Section 3.3.2, insert provisions for such modifications.)

« If the Work from which retainage is withheld is fifty percent complete and if the Contractor has performed Work in accordance with the provisions of the Contract Documents, no more than five percent (5%) of any additional progress payment may be withheld as retainage if the Contractor provides or has provided satisfactory and reasonable assurances of continued performance and financial responsibility to complete the Work. Except as provided otherwise herein, the Owner shall have the option, but not the obligation, to reduce the retainage requirements of this Agreement or release any portion of retainage prior to the date specified in the Contract Documents. Any reduction or release of retainage, or portion thereof, however, shall not be a waiver of (i) any of the Owner's rights to retainage in connection with other payments to the Contractor or (ii) any other right or remedy that the Owner has under the Contract Documents, at law or in equity. »

§ 5.1.7.3 Except as set forth in this Section 5.1.7.3, upon Substantial Completion of the Work, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted at Substantial Completion shall not include retainage as follows:

(Insert any other conditions for release of retainage upon Substantial Completion.)

« N/A »

~~§ 5.1.8 Intentionally deleted. If final completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A201–2017.~~

§ 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 including~~ the Contractor's responsibility to correct Work as provided in Article 12 of AIA Document A201–2017, ~~and but excluding the Contractor's responsibility~~ to satisfy other requirements, if any, which extend beyond final payment; and
- .2 a final Certificate for Payment has been issued by the Architect, ~~the Contractor has provided all documents required by Sections 3.5.7 and 9.10.2 of AIA Document A201–2017, as amended, and the Owner's Board of Education has voted to accept the Work and approve Final Payment.~~

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

«—»

§ 5.3 Interest

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.)

~~« six percent (6%) per annum » % «—»~~

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

~~The Contractor and Owner may mutually agree to submit to mediation any claim, dispute, or other matter in question arising out of or related to this Agreement, but shall not be obligated to do so as a prerequisite of instituting any legal action. If the parties agree to engage in mediation, they shall share in the payment of mediator's fees and filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon by the Contractor and Owner.~~

~~The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201–2017, unless the parties appoint below another individual, not a party to this Agreement, to serve as the 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.)~~

«—»

«—»

«—»

«—»

§ 6.2

~~Notwithstanding any reference to arbitration contained in this Agreement, neither the Contractor nor the Owner shall be obligated to resolve any Claim through arbitration.~~

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Binding Dispute Resolution

For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A201-2017, the method of binding dispute resolution shall be as follows:
(Check the appropriate box.)

☐ Arbitration pursuant to Section 15.4 of AIA Document A201-2017

☐ Litigation in a court of competent jurisdiction

☐ Other (Specify)

☐

§ 6.3 The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201-2017 for Claims arising from or relating to the Contractor's Construction Phase services, unless the parties appoint below another individual, not a party to the Agreement, to serve as the Initial Decision Maker. If the Owner and Contractor do not select a method of binding dispute resolution, 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.

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 A201-2017.

§ 7.1.1 If the Contract is terminated for the Owner's convenience in accordance with Article 14 of AIA Document A201-2017, then the Owner shall pay the Contractor a termination fee as follows:

(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner's convenience.)

«Zero Dollars (\$0.00) »

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201-2017.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201-2017 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 The Owner's representative:

(Name, address, email address, and other information)

« Matt Herzog or Chris Bilau »
« Project Advocates, LLC »
« 1313 Cuming Street, Suite 200 »
« Omaha, NE 68102 »
« 402-578-7216 »
« matt@project-advocates.com »

§ 8.3 The Contractor's representative:

(Name, address, email address, and other information)

« -> »
« -> »
« -> »
« -> »
« -> »
« -> »

§ 8.4 Neither the Owner's nor the Contractor's representative shall be changed without ten days' prior notice to the other party.

§ 8.5 Governing Law

Section 13.1 of AIA Document A201–2017 applies to the Construction Phase.

§ 8.6 Fair Labor Standards

The Contractor shall maintain fair labor standards throughout the performance of this Contract. The Contractor shall file with the Owner a statement that the Contractor is complying with, and will continue to comply with, fair labor standards in the pursuit of its business and in the execution of the Contract. Any additional contract entered into between Contractor and Owner shall include a provision that in the execution of the contract, fair labor standards shall be maintained. For purposes of this section, the phrase "fair labor standards" means such a scale of wages and conditions of employment as are paid and maintained by at least fifty percent of the contractors in the same business or field of endeavor as the Contractor.

§ 8.7 Payment of Unemployment Compensation

The Contractor shall pay to the Unemployment Compensation Fund of the State of Nebraska and the State Unemployment Insurance Trust Fund unemployment combined tax and interest due under the Employment Security Law on wages paid to individuals employed in the performance of the Contract as required by NEB. REV. STAT. § 48-657.

§ 8.8 If for any reason whatsoever, any one or more of the provisions of this Agreement shall be held or deemed to be inoperative, unenforceable or invalid as applied to any particular case or in all cases, such circumstances shall not have the effect of rendering such provision invalid in any other case or of rendering any other provision of this Agreement inoperative, unenforceable or invalid.

§ 8.9 The Contractor shall use a federal immigration verification system to determine the work eligibility status of employees hired on or after October 1, 2009, and who are physically performing services within the State of Nebraska. If the Contractor employs or contracts with any Subcontractor in connection with this Agreement, the Contractor shall include a provision in the contract requiring the Subcontractor to use a federal immigration verification system to determine the work eligibility status of new employees physically performing services within the State of Nebraska.

§ 8.10 Indemnification

§ 8.10.1 To the fullest extent permitted by law, the Contractor shall defend, indemnify, and hold harmless the Owner and its officers, board members, employees, agents, consultants, and representatives (the "Indemnitees") from and against any and all claims, demands, damages, losses, expenses, lawsuits, actions, cross-claims, counterclaims, third-party actions, liens, damages, debts, obligations, exemplary damages, consequential damages, punitive damages, liabilities, judgments, and causes of action (including without limitation reasonable consultants' and attorneys' fees and expenses), that arise out of, are related to, or are in connection with this Agreement, the Project, the Work, the Contractor's services, the Contractor's performance hereunder, and/or the Contractor's conduct at or related to the Project or the Owner's property (hereinafter "Indemnity Claims"), provided that any such Indemnity Claim is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property, including the loss of use of the same, but only to the extent caused by the intentional, reckless, or negligent acts or omissions of the Contractor, its subcontractors, sub-subcontractors, or its material suppliers, or anyone directly or indirectly employed by them, or anyone for whose acts they may be liable. 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 8.10.

Notwithstanding the foregoing, the Contractor's obligations in this Section 8.10 specifically except any obligation to hold harmless, defend, or indemnify an Indemnitee against any Indemnity Claim solely caused by such Indemnitee's own negligent conduct.

§ 8.10.2 The indemnification obligation under this Section 8.10 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for Contractor or anyone directly or indirectly employed by them, under workers' compensation acts, disability benefit acts or other employee benefit acts.

§ 8.11 The Contractor and all Subcontractors, if any, shall not discriminate against any employee or applicant who is to be employed for performance of this Agreement with respect to his or her hire, tenure, terms, conditions, or privileges of employment, because of his race, color, religion, sex, disability, or national origin.

§ 8.12 The Contractor and all Subcontractors, if any, shall not manufacture, sell, distribute, dispense, possess or use controlled substances or marijuana, as defined by Nebraska law, during the performance of this Agreement while on school premises or at school related functions. The Contractor and all Subcontractors, if any, shall not possess any weapon, as defined by Nebraska law and the federal "Drug-Free Schools Act," on school property or at school related functions. The Contractor and all Subcontractor, if any, also shall adhere to all District's policies and regulations that prohibit the possession, distribution, sale, dispensation, or use of any alcohol or tobacco products while on school premises or at school related functions. Failure to comply with this provision may be considered a material breach. The District may suspend or terminate the Contractor, Subcontractor, or both if it violates these laws, regulations, or policies or this provision.

§ 8.13 No delay or omission by either of the parties hereto in exercising any right or power accruing upon the noncompliance or failure of performance by the other party hereto of any of the provisions of this Agreement shall impair any such right or power or be construed to be as waiver thereof. A waiver by either of the parties hereto of any of the covenants, conditions or agreements hereof to be performed by the other party hereto shall not be construed to be a waiver of any subsequent breach thereof or of any other covenant, condition or agreement herein contained.

§ 8.14 The Contractor's federal employer identification number is: [REDACTED]

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§ 8.15 The Contractor acknowledges that the Owner must comply with NEB. REV. STAT. § 84-712 through § 84-713 and release public records as defined law upon request, which may include this Agreement and all records created and maintained in relation to this Agreement.

§ 8.16 When present on Owner's property, Contractor and its employees and subcontractors or anyone directly or indirectly employed by or representing any of them, shall:

- .1 wear uniform at all times with company identification;
- .2 carry photo identification;
- .3 not smoke or otherwise use tobacco;
- .4 not use, or be under the influence of, alcohol or drugs;
- .5 not carry a firearm or other weapon; and
- .6 comply with all of the school district's rules, policies, procedures which are intended to protect the safety and health of its faculty, staff, students, and visitors

§ 8.17 The Contractor shall conduct a background check for all employees or subcontractors providing services under this Agreement in a manner approved by Owner. Owner will determine if the person is authorized to provide services, in accordance with state, federal and local policy.

§ 8.5 Insurance and Bonds

§ 8.5.1 The Owner and the Contractor shall purchase and maintain insurance as set forth in AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

§ 8.5.2 The Contractor shall provide bonds as set forth in AIA Document A101™–2017 Exhibit A, and elsewhere in the Contract Documents.

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, if completed, or as otherwise set forth below:

(If other than in accordance with AIA Document E203–2013, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)

« »

§ 8.7 Other provisions:

« »

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

- .1 AIA Document A101™-2017, Standard Form of Agreement Between Owner and Contractor, as amended
- .2 AIA Document A101™-2017, Exhibit A, Insurance and Bonds, as amended
- .3 AIA Document A201™-2017, General Conditions of the Contract for Construction, as amended
- .4 AIA Document E203™-2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:

(Insert the date of the E203-2013 incorporated into this Agreement.)

« »

- .5 Drawings

Westside High School Renovations – Restrooms Package – Construction Documents Prepared by BVH Architects dated February 13, 2024

Number	Title	Date

- .6 Specifications

Westside High School Cooling Tower & Enclosure – Project Manual Prepared by TACK Architects dated October 24, 2025

Section	Title	Date	Pages

- .7 Addenda, if any:

Number	Date	Pages

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

- .8 Other Exhibits:

(Check all boxes that apply and include appropriate information identifying the exhibit where required.)

[« »] AIA Document E204™-2017, Sustainable Projects Exhibit, dated as indicated below:
(Insert the date of the E204-2017 incorporated into this Agreement.)

« »

[« »] The Sustainability Plan:

Title	Date	Pages

[« »] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

- .9 Other documents, if any, listed below:
(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201™-2017 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements, and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreement. Any such documents should be listed here only if intended to be part of the Contract Documents.)

« »

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

OWNER (Signature)

« »« »

(Printed name and title)

CONTRACTOR (Signature)

« »« »

(Printed name and title)

DRAFT AIA® Document A201® – 2017

General Conditions of the Contract for Construction

for the following PROJECT:

(Name and location or address)

«

Westside High School Fluid Cooler Project:

- Project Location: Westside High School 8701 Pacific Street Omaha, Nebraska:
- Project Description: Install Owner supplied fluid cooler in an owner provided precast enclosure. Westside High School to remain occupied during construction.

[Hereinafter referred to as "the Project".]» »

« »

THE OWNER:

(Name, legal status and address)

« Douglas County School District 28-0066 a/k/a Westside Community Schools,
A political subdivision of the State of Nebraska

909 South 76th Street

Omaha, NE 68114-4599

Telephone Number: (402) 390-2100, hereinafter referred to as "Owner". »« »

« »

THE ARCHITECT:

(Name, legal status and address)

« TACK Architects, Inc. »« »

« 2922 North 61st Street, Studio 1 »

« Omaha, NE 68104 »

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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.

For guidance in modifying this document to include supplementary conditions, see AIA Document A503™, Guide for Supplementary Conditions.

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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~~ The Contract Documents 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 or proposal 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. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

§ 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 and reasonably inferable in 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. . In the event of inconsistencies within or between parts of the Contract Documents,

or between the contract Documents and applicable standards, codes, and ordinances, the Contractor shall (i) provide the better quality or greater quantity of Work or (ii) comply with the more stringent requirement; either or both in accordance with the Architect's interpretation. The terms and conditions of this Subparagraph 1.2.1, however, shall not relieve the Contractor of any of the obligations set forth in Subparagraphs 3.2 and 3.7.

§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

§ 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 retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and 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 the 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 suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, 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 suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 1.7 Digital Data Use and Transmission

The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. The parties will use AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

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 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Prior to commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.

§ 2.2.2 Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents.

§ 2.2.3 After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.4 Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 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.

§ 2.3.2 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.

§ 2.3.3 If the employment of the Architect terminates, the Owner shall employ a successor to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

§ 2.3.4 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.

§ 2.3.5 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.

§ 2.3.6 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.

§ 2.4 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.

§ 2.5 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 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 default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the ~~Architect and the Architect-Initial Decision Maker and the Initial Decision Maker~~ may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such ~~deficiencies, deficiencies or performing~~ such work, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the ~~Architect-Initial Decision Maker~~, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

§ 2.6 Extent of Owner Rights

§ 2.6.1 The rights stated in this Article 2 and elsewhere in the Contract Documents are cumulative and not in limitation of any rights of the Owner (i) granted in the Contract Documents, (ii) at law or (iii) in equity.

§ 2.6.2 In no event shall the Owner have control over, charge of, or any responsibility for construction means, methods, techniques, sequences, or procedures or for safety precautions and programs in connection with the Work, notwithstanding any of the rights and authority granted the Owner in the Contract Documents.

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 and all persons used by the Contractor to provide services under the Contract Documents 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~~ Documents and all federal, state, and local laws, regulations, and ordinances.

§ 3.1.3 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Owner or 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 2.3.4, 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 and Owner any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect or Owner 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 and Owner any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect or Owner 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 submit 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, subject to Section 15.1.7, 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. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be 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 propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed

construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative 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 approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 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.

3.4.4 The Contractor is responsible for the management of the Project to avoid strikes, work stoppages, labor disputes or any disturbances by workers employed by the Contractor or its subcontractors on or in connection with the Work or the Project or the location thereof that will delay completion of the Project.

§ 3.5 Warranty

§ 3.5.1 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~~ shall 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~~ Architect or Owner, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

§ 3.6 Taxes

The Contractor shall pay sales, consumer, renovation/remodel, 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 14 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 that an equitable adjustment be made 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, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15. No adjustment in the Contract Time or Contract Sum shall be permitted, however, in connection with a concealed or unknown condition that does not differ materially from those conditions disclosed or that reasonably should have been disclosed by the Contractor's (i) prior inspections, tests, reviews, and preconstruction services for the Project, or (ii) inspections, tests, reviews, and preconstruction services that the Contractor had the opportunity to make or should have performed in connection with the Project.

§ 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.

§ 3.7.6 Coordination of Utilities.

Contractor shall be responsible for the coordination of public and private utilities for the project, including electricity, water, sewer, storm water, natural gas, telephone, internet, and cable television. The Contractor will initiate contact with the representatives of the utilities when the Work has begun and will maintain liaison with them to ensure that all preparatory on-site and off-site work required by Contractor and/or the utilities and the associated inspections and permitting are coordinated so as to avoid negatively impacting the Construction Schedule. The Owner shall be responsible for payment of all utility installation fees. The Owner will advise the Contractor of the low voltage providers, and the Contractor will provide the necessary coordination to ensure the orderly preparations for and installation of the low-voltage services. All public and private utility fees required for the installation of utilities shall be paid for by the Owner.

§ 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 and Project Manager

§ 3.9.1 The Contractor shall employ a competent superintendent and project manager 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 within 14 days~~ after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed ~~superintendent. Within 14~~ superintendent and project manager. Within 7 days of receipt of the information, the Architect or Owner may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect or Owner to provide notice within the ~~14 day 7-day~~ period shall constitute notice of no reasonable objection.

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

§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, ~~promptly after being awarded the Contract, prior to first pay application submission,~~ shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised ~~at appropriate intervals in monthly intervals, or more frequently~~ as required by the conditions of the Work and Project. The Contractor acknowledges that the Project Schedule accounts for normal weather delays as defined by the National Oceanic and Atmospheric Administration (NOAA) for the local Project area in the last 25 years in order to achieve the scheduled date of Substantial Completion.

§ 3.10.1.1 The Project Schedule shall be a valid CPM schedule generated by a commercially available CPM scheduling software application for the duration of the Project. The Project Schedule shall begin with the Notice to Proceed, and end with the Final Completion Date. The Project Schedule shall include and display, as a minimum, dates for submissions and processing of submittals, procurement, all work activities, commissioning, Owner activities and closeout activities. It shall be organized by Phase, Area, or other logical sequence. Activities shall be logically connected, and the Project Schedule shall include the total float for each activity and a clearly identifiable chain of critical-path (zero-float) activities. The Project Schedule shall account for holidays and other non-workdays and shall conform to industry standards for CPM scheduling. Artificial constraints and fixed milestone dates shall not be used, except for dates which are stipulated in the Agreement.

§ 3.10.1.2 The initial (Baseline) Project Schedule shall be submitted for approval within 15 days of receipt of Notice to Proceed and shall include all early and late completion dates by activities, and activity durations. Valid monthly updates utilizing industry-standard updating procedures shall be submitted a minimum of 2 working days before each Application for Payment. Updates shall accurately reflect the progress of the Work, any Change Order Work for which additional contract days were allowed, and any suspensions of Work directed by the Owner. Updates shall show early and late start and completion dates, actual start and completion dates of all completed activities, percentage of completion, and remaining working days for each activity in progress. The Contractor shall provide Project Schedule updates to the Owner in the original software format and PDF format.

§ 3.10.1.3 The Contractor shall promptly make any corrections to the Project Schedule reported by the Owner and shall resubmit a corrected Project Schedule within 5 days, if so directed by the Owner. Weather days beyond those anticipated shall be tracked separately, and not identified as activities in the Project Schedule. Time extensions

resulting from unresolved claims or voluntary suspensions by the Contractor shall not be included in the Project Schedule. Project Schedules shall not contain negative float.

§ 3.10.1.4 The Contractor shall provide an as-built Project Schedule at Final Completion of the Work.

§ 3.10.1.5 The Contractor shall prepare recovery schedules as requested by Architect or Owner.

§ 3.10.2 The Contractor, promptly after being awarded the Contract prior to first pay application submission and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's or Owner's approval. The Architect's or Owner's approval shall not be unreasonably 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, or fails to provide submittals in accordance with the approved 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.

§ 3.10.3 The Contractor shall perform the Work and in all other respects, conform with the most recent Project Schedule submitted to the Owner and Architect. Contractor and Owner agree that resubmitted schedules are submitted to Owner for information purposes, and not approved unless such resubmitted schedule shall change the Contract time. Notwithstanding the foregoing, approval by either or both of the Architect and Owner is not intended nor shall same be construed, inferred, or result in either or both of the Owner or Architect being responsible or liable for means, methods, techniques, or any other respect of the obligations, responsibilities or liabilities of the Contractor hereunder.

§ 3.10.4 Each update to the Project Schedule shall (i) provide a graphic representation of all activities and events that will occur during performance of the Work (ii) identity each major task of construction and the anticipated start and anticipated completion date, and (iii) set forth dates that are critical in ensuring the timely and orderly completion of the work. If requested by the Owner or Architect, the Contractor will update the Project Schedule.

§ 3.10.5 Contractor shall provide a short interval schedule that includes, at a minimum, two weeks in the past and three weeks ahead of the current date. Short Interval schedule to be provided prior to all Owner, Architect and Contractor meetings.

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, electronically and at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and 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 how 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 the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect 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 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.

§ 3.12.10.1 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 be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately 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 and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and 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.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

§ 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, 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, or patching shall be restored to the condition existing prior to the cutting, fitting, or 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 construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its 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 and 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 the Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 Access to Work

The Contractor shall provide the Owner and Architect with 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 indemnify and hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for 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 an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect and Owner.

§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall defend, indemnify and hold harmless the Owner, Owner's Representative, Architect, Architect's consultants, and their agents and employees of any of them from and against claims, third party 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 or wrongful acts or omissions or a breach of this Contract by 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.

§ 3.18.3 Provided that required progress payments are made in a timely manner, the Contractor agrees to keep the Owner's property free and clear of liens, lien claims or stop-work notices relating to the Work under this Agreement. The Contractor agrees to indemnify, defend, and hold the Owner harmless from all liens, lien claims, and stop-work notices recorded, asserted or filed on the Work or on any property on which the Work is performed, on account of any labor performed or materials furnished by the Contractor or its Subcontractors or suppliers in connection with the Work. The Contractor's obligation hereunder includes paying for any attorney's fees and court and other costs incurred by the Owner in connection with such liens and lien claims.

ARTICLE 4 ARCHITECT

§ 4.1 General

§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

§ 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.

§ 4.2 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. shall administer the performance of the Work. The Architect will advise the Owner and Contractor with regard to matters set forth in the Drawings and Specifications. In addition to any specific responsibilities assigned elsewhere in the Contract Documents, the Architect shall decide any and all questions which may arise as to the rate of progress of the Work.~~ The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract ~~Documents.~~ Documents, unless otherwise modified by written instrument in accordance with Section 4.1.2.

§ 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.

§ 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 promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) 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

The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

§ 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. All payments to the Contractor shall be subject to approval by the Owner.

§ 4.2.6 The Architect ~~has or~~ Owner have authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect or Owner will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect or Owner 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 or Owner to the Contractor, Subcontractors, 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 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 order 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 Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 4.2.11 The Architect or Owner 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 or Initial Decision Maker 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 or Initial Decision Maker 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-recommendations~~ on matters relating to aesthetic effect as approved by the Owner 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 the 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, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice 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 responsively in submitting names as required.

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

§ 5.3 Subcontractual Relations

By appropriate written agreement, 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 that the Contractor, by these Contract 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. All subcontracts shall be in writing and shall specifically provide that the Owner is an intended third-party beneficiary of such subcontract.

§ 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; 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 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 term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

§ 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 any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its 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 or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has 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 notify the Architect and Owner of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect and Owner of apparent discrepancies or defects prior to proceeding with the Work 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. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

§ 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 that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor 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 [or Owner](#) 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. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work. Except as permitted in Paragraph 7.3 and Subparagraph 9.7.1, a change in the Contract Sum or the Contract Time shall be accomplished only by Change Order. Accordingly, no course of conduct or dealings between the parties, nor express or implied acceptance of alterations or additions to the Work, and no claim that Owner has been unjustly enriched by an alteration of or addition to the Work, whether or not there is, in fact, any unjust enrichment to the Work, shall be the basis of any claim to an increase in any amounts due under the Contract Documents or a change in any time period provided for in the Contract Documents.

§ 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 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine 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 7.3.4 shall be limited to the following:

- .1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;
- .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, directly related to the change; and
- .5 Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 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.

§ 7.3.7 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.

§ 7.3.8 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 may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and [Owner and](#) shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect [and Owner](#) that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

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, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

§ 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 (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by ~~labor disputes~~, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; ~~or (5) (5) Force majeure; or (6)~~ by other causes that the Contractor asserts, and the Architect or Owner determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect or Owner may determine. Time extensions shall only be granted for delays to the extent that they impact Critical Path activities, as demonstrated on the most recent approved Construction Schedule.

§ 8.3.1.1 Elements constituting force majeure are: civil disorder, inability to procure materials for reasons beyond the control of the Contractor and other than by reason of failure to make payment, failure of one or more utilities, restrictive governmental law or regulations by imposition of enforcement, government action, riot, insurrection, war, fuel shortage, act of God, undue or unusual delay in acting or failure to act any agency or any employee thereof, or any other governmental entity whose action may be required for any purpose, or similar events or conditions beyond the reasonable control of the Owner. The Contractor has no entitlement and the Owner has no liability for (a) any costs, losses, expenses, damages or the payment of any part of the contract price during an event of force majeure; and (b) any delay costs in any way incurred by the contractor due to an event of force majeure.

§ 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. Notwithstanding anything to the contrary in the Contract Documents, an extension in the Contract Time, to the extent permitted under Section 8.3.1, shall be the sole remedy of the Contractor for any (i) delay in the commencement, prosecution, or completion of the Work, (ii) hindrance, interference, suspension or obstruction in the performance of the work, (iii) loss of productivity, or (v) other similar claims (items i through iv herein collectively referred to in this Section 8.3.3 as "Delays") whether or not such Delays are foreseeable, unless a Delay is caused by acts of the Owner, and only to the extent such acts continue after the Contractor furnishes the Owner with notice of such interference. In no event shall the Contractor be entitled to any compensation or recovery of any damages, in connection with any Delay, including, without limitation, consequential damages, lost opportunity costs, impact damages, or other similar remuneration. The Owner's exercise of any of its rights or remedies under the Contract Documents (including, without limitation, ordering changes in the Work, or directing suspension, rescheduling, or correction of the Work), regardless of the extent or frequency of the Owner's exercise

of such rights or remedies, shall not be construed as intentional interference with the Contractor's performance of the Work.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

§ 9.1.1 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.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 9.2 Schedule of Values

~~Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment. The Contractor shall submit to the Architect and the Owner for their approval, before the first Application for Payment, a schedule of values allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. Work and prepared in such form and supported by such data to substantiate its accuracy as the Architect or Owner may require. This schedule, unless objected to by the Architect, the Architect or the Owner, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.~~
Applications for Payment.

9.2.1 The Schedule of Values shall be the budgets for the direct cost of each work item. The Original Schedule of Values shall remain unchanged during the project. The Original Schedule of Values shall be a breakdown of all direct costs of construction, net of contractor general conditions, overhead, and profit. The SOV shall include a single line each for General Conditions, Allowances, Contractor Contingency, Overhead, and Profit.

9.2.3 Adjustments to the Schedule of Values may be made only for Change Orders and adjustments to budgeted items requested by the Contractor and Approved by the Owner. Contractor shall maintain a ledger listing each change to each line item and present a current SOV with each pay request. The sum total of the Original SOV column shall be equal to the original contract sum, and the sum total of the Adjusted SOV column shall be equal to the original contract sum plus all fully-executed change orders.

9.2.4 If the contract includes a Contractor Contingency, it shall be available to the Contractor to cover any buyout shortages in Cost of Work items. It may not be used to supplement General Conditions, Allowances, or Contractor fees, unless mutually agreed by Contractor and Owner. Unused portions of Cost of Work items shall revert to the Contractor Contingency and may be used to cover over-runs in other line items.

9.2.5 Owner shall have the right to decline approval for change to the SOV for work items for which costs were included due to Contractor or Subcontractor error or gross negligence.

§ 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 and Owner 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. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and 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 supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.1.3 Each Application for Payment shall be accompanied by the following, all in form and substance satisfactory to the Owner, Architect, and Escrow Agent and otherwise in accordance with state law:

1. A current Contractor's lien waiver in the specified form
2. If requested, A Contractor's Sworn Statement conforming to applicable statutes, duly executed and acknowledged, showing all Subcontractors and material suppliers with whom the Contractor has entered into subcontractor agreements or purchase orders, the amount of each such subcontract or purchase order, the amount requested for any Subcontractor or material supplier in the requested progress payment and the to become due from such progress payment, together with similar sworn statements from all such Subcontractor and supplier, and AIA G703 breakdowns for all Subcontractors and material suppliers.
3. Duly executed waivers of mechanics and materialmen's liens from all Subcontractors of any tier and from suppliers and materialmen.
4. Stored materials documentation for all items showing balances in the Stored Materials column of the Pay Application, including the physical address of the storage facility, a current manifest, current photographs, insurance coverage in acceptable form, and a signed affidavit from the custodian of the materials.
5. All documents required to comply with the requirements of the Contract Documents and/or reasonably requested by the Escrow Agent, Owner, or Architect
6. A current Schedule of Values and Project Schedule.

§ 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, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

§ 9.3.4 Contractor shall submit Applications for Payment using AIA Documents G702 and G703 Application and Certificate of Payment (or G702CMA, if applicable) and Continuation Sheet. All blanks in the form must be completed and signatures of Contractor and Notary Public must be original on each form. Incomplete or inaccurate Applications for Payment shall be returned to the Contractor by the Architect for completion and/or correction. Owner shall have no responsibility for payment of same if the Application for Payment is incomplete or inaccurate.

§ 9.3.5 By signing each Application for Payment, the Contractor stipulates and certifies to the following: that the information presented is true, correct, accurate and complete; that the Contractor has made the necessary detailed examinations, audits and arithmetic verifications; that the submitted Work has been completed to the extent represented in the Applications for Payment; that the materials and supplies identified in the Applications for Payment have been purchased, paid for and received; that the subcontractors have been paid as identified in the Applications for Payment or that Contractor has been invoiced for same; that he has made the necessary on-site inspections to confirm the accuracy of the Applications for Payment; that there are no known mechanics' or materialmen's liens outstanding at the date of this requisition; all due and payable bills with respect to the Work have been paid to date or are included in the amount requested in the current application; that, except for such bills not paid but so included, there is no known basis for the filing of any mechanics' or materialmen's liens on the Work; that the Payment Application includes only Work self-performed by Contractor or for which Contractor has been invoiced; and that releases from all Subcontractors and materialmen have been obtained in such form as to constitute an effective release of lien under the laws of the State of Nebraska covering all Work performed and for

which payment has been made by the Owner to the Contractor. Contractor understands that documents submitted to Owner become government documents under the laws of the State of Nebraska. Contractor further understands that falsification of Contractor's Application for Payment may constitute a violation of the penal laws of the State of Nebraska and may justify termination of Contractor's Contract with Owner.

§ 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole 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 in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. 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. 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 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.

§ 9.4.3 Notwithstanding any other provision in this Agreement, the issuance of a Certificate for Payment shall constitute a recommendation to the Owner regarding the amount to be paid. This recommendation is not binding on the Owner if Owner knows of other reasons under the Contract Documents why payment should be withheld.

§ 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 suppliers 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 either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

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

§ 9.5.4 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 supplier 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 Contractor shall reflect such payment on its next Application 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 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 and suppliers 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 or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor's payments to 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 or provided by 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, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the ~~Owner~~ Owner, other indemnities, the Project, and property from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

§ 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' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and~~

~~the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.~~ § 9.7.1 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' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.7.2 If the Owner is entitled to reimbursement or payment from the Contractor under or pursuant to the Contract Documents, such payment shall be made promptly upon demand by the Owner. Notwithstanding anything contained in the Contract Documents to the contrary, if the Contractor fails to promptly make any payment due the Owner, or if the Owner incurs any costs and expenses to cure any default of the Contractor or to correct defective Work, the Owner shall have an absolute right to offset such amount against the Contract Sum and may, in the Owner's sole discretion, elect either to (i) deduct an amount equal to that which the Owner is entitled from any payment then or thereafter due the Contractor from the Owner, or (ii) issue a written notice to the Contractor reducing the Contract Sum by an amount equal to that which the Owner is entitled.

§ 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; provided, however, that as a condition precedent to Substantial Completion, the Owner has received all certificates of occupancy and any other permits, approvals, licenses, and other documents from any governmental authority having jurisdiction thereof necessary for the beneficial occupancy of the Project.

§ 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 and Owner 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; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and 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 the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the 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 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 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. 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 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. All warranties and guarantees required under or pursuant to the Contract Documents shall be assembled and delivered by the Contractor to the Architect and Owner as part of the final Application for Payment. The final Certificate for Payment will not be issued by the Architect until all warranties and guarantees have been received and accepted by the Owner.

§ 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, (3) a written statement that the Contractor knows of no 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, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and 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, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance 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 the lien, claim, security interest, or encumbrance, 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, corrected, 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 the 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;
- .3 terms of special warranties required by the Contract Documents; or
- .4 audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a 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, a Subcontractor, or a Sub-subcontractor; 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 implement, 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 the owners and users of adjacent sites and utilities of the safeguards.

§ 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. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is 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, notice of the injury or damage, whether or not insured, shall

be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.2.9 When present on the Owner's property, the Contractor, Subcontractors, a Sub-subcontractor, or anyone directly or indirectly employed by or representing any of them, shall

- .1 wear uniform at all times with company identification;
- .2 carry photo identification;
- .3 not smoke or otherwise use tobacco;
- .4 not use, or be under the influence of, alcohol or drugs;
- .5 not carry a firearm or other weapon; and
- .6 comply with all of the Owner's rules, policies, procedures which are intended to protect the safety and health of its faculty, staff, students, and visitors.

§ 10.3 Hazardous Materials and Substances

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. 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 notify the Owner and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's 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 the material or substance or who are to perform the task of removal or safe containment of the 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 by the amount of the Contractor's reasonable additional costs of shutdown, 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-Owner's gross negligence or wrongful conduct with hazardous materials which 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 hazardous 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 hazardous 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 reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances 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 reimburse 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 Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Owner's Representative, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 11.1.3 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.

§ 11.1.4 Notice of Cancellation or Expiration of Contractor's Required Insurance. Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Owner's Insurance

§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

§ 11.2.2 Failure to Purchase Required Property Insurance. If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

§ 11.2.3 Notice of Cancellation or Expiration of Owner's Required Property Insurance. Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance

required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

§ 11.3 Waivers of Subrogation

§ 11.3.1 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; (2) the Architect and Architect's consultants; and (3) Separate Contractors, 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 those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

§ 11.3.2 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, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.

§ 11.5 Adjustment and Settlement of Insured Loss

§ 11.5.1 A loss insured under the ~~property insurance required by the Agreement~~ builder's risk or all risk insurance required by the Agreement, if purchased by the Owner, 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 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner. A loss under the builder's risk or all risk insurance, if purchased by the Contractor, shall be adjusted by Contractor as a fiduciary for the Owner.

§ 11.5.2 Prior to settlement of an insured loss, the Owner ~~shall notify the Contractor or Contractor (as the case may be)~~ shall notify the other party of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The ~~Contractor~~ other party shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the ~~Contractor does not object, the Owner shall settle the loss and the Contractor party does not object, the loss may be settled and the party~~ shall be bound by the settlement and allocation. Upon receipt, the ~~Owner~~ party shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any

dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

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 or Owner's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, Architect or Owner, 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, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, 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 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- Contractor~~. 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 2.5.

§ 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. Upon completion of any Work under or pursuant to this Section 12.2, the one (1)-year correction period in connection with the Work requiring correction shall be renewed and recommence. The obligations under Paragraph 12.2 shall cover any repairs and replacement to any part of the Work or other property that is damaged by the defective Work.~~

§ 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 of the Owner or Separate Contractors, whether completed or partially completed, 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, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.~~ laws of the State of Nebraska. Any litigation shall be conducted in the state or federal court that has jurisdiction over the county in which the Project is located.

§ 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 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 the assignment.

§ 13.3 Rights and Remedies

§ 13.3.1 ~~Duties~~ Except as expressly provided in the Contract Documents, 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.

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

§ 13.4 Tests and Inspections

§ 13.4.1 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 tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 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 13.4.1, 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 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 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.

§ 13.4.4 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.

§ 13.4.5 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.

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

§ 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties 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.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The ~~Contractor~~ Contractor, as mutually agreed with the Owner, suspend the Work or may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, 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 reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor ~~may may, as mutually agreed with the Owner, suspend the Work or~~ terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, 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' notice to the Owner and Architect, as mutually agreed with the Owner, suspend the Work or, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable ~~overhead and profit on Work not executed, and overhead, and~~ costs incurred by reason of such termination. The Contractor shall not be entitled to any consequential, indirect, or incidental damages.

§ 14.1.4 If the Work is stopped for a period of 60-90 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work 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' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

14.1.5 Notwithstanding anything to the contrary in this Contract or in this Section 14.1, the Contractor may not terminate the Contract or suspend Work because of the Owner's failure to make payment, if a reasonable dispute exists regarding the payment amount due and owing to the Contractor and the Owner has paid all undisputed amounts to the Contractor.

§ 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 or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
- .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 reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner 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' 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 under 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. Intentionally deleted.~~

§ 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 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 Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement. The Contractor shall not be entitled to any

[consequential, indirect or incidental damages or overhead 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, a change in the Contract Time, 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. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

[§ 15.1.1.2 The Contractor acknowledges that the Owner is a political subdivision of the State of Nebraska, and, as such, may enjoy immunities from suit and/or liability under the Constitution and laws of the State of Nebraska. By entering into this Agreement, the Owner does not waive any of its immunities from suit and/or liability, except as otherwise specifically provided herein and as specifically authorized by law.](#)

§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the 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 15.1.2.

§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by 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 under this Section 15.1.3.1 shall be initiated within 24-10 days after occurrence of the event giving rise to such Claim or within 24-10 days after the claimant first recognizes the condition giving rise to the Claim, whichever ~~is later~~ is later; provided, however, that the claimant shall use its best efforts to furnish the Initial Decision Maker and the other party, as expeditiously as possible, with notice of any Claim including, without limitation, those in connection with the concealed or unknown conditions, once such claim is recognized, and shall cooperate with the Architect and the party against whom the claim is made in any effort to mitigate the alleged or potential damages, delay, or other adverse consequences arising out of the condition that is the cause of such a Claim. Claims may also be reserved in writing within the time limits set forth in this Section 15.1.3. If a Claim is reserved, the Resolution of Claims and Disputes procedures described in this Section 15.2 shall not commence until a written notice from the claimant is received by the Initial Decision Maker. Any notice of Claim or reservation of Claim must clearly identify the alleged cause and the nature of the Claim and include data and information then available to the claimant that will facilitate prompt verification and evaluation of the Claim.

§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 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.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

§ 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 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.

§ 15.1.6.2 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.

§ 15.1.7 Waiver of Claims for Consequential Damages

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this ~~Contract~~ Contract in excess of five hundred thousand dollars (\$500,000). 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 ~~14-14~~ in excess of five hundred thousand dollars (\$500,000). Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 Initial Decision

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The ~~Architect~~ Owner's Representative 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. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a 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 the 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 receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, 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 15.1.7, ~~shall be subject to mediation as a condition precedent to binding dispute resolution~~ may be subject to mediation provided that mediation shall not be a condition precedent to any other binding dispute resolution, including litigation.

§ 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.~~ Contract.

§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

§ 15.3.4 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 OMIT

§ 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. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. 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 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party 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 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party 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 those of the Owner and Contractor under this Agreement.~~

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. Phased construction.
4. Work by Owner.
5. Work under separate contracts.
6. Purchase contracts.
7. Owner-furnished products.
8. Contractor-furnished, Owner-installed products.
9. Access to site.
10. Coordination with occupants.
11. Work restrictions.
12. Specification and drawing conventions.

- 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: Westside High School Cooling Tower.

1. Project Location: 8701 Pacific Street, Omaha NE 68114

- B. Owner: Westside Community Schools.

1. Owner's Representative: Chris Bilau, Project Advocates, 402-507-0844, chrisb@project-advocates.com.

- C. Architect: Chris Houston, TACKarchitects, Inc., 402-505-9778, chouston@tackarch.com.

- D. Architect's Consultants: The Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:

1. Mechanical Engineer: Morrissey Engineering, 402-491-4144.
2. Electrical Engineer: Morrissey Engineering, 402-491-4144.

3. Structural Engineer: Thompson, Dreessen & Dorner, Inc, 402-330-8860.
4. Civil Engineer: Lamp Rynearson, 402-496-2498
- E. Project Coordinator for Multiple Contracts: Chris Bilau, Project Advocates, 402-507-0844, chrisb@project-advocates.com, has been appointed by Owner to serve as Project coordinator.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
 1. New cooling tower enclosure, cooling tower and associated site and MEP systems. The existing school building and site will be occupied during the duration of construction.
- B. Type of Contract:
 1. Project will be constructed under a single prime contract.
- C. Before commencing Work of each phase, submit an updated copy of Contractor's construction schedule showing the sequence, commencement and completion dates, and move-out and -in dates of Owner's personnel for all phases of the Work.

1.5 WORK UNDER SEPARATE CONTRACTS

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

1.6 PURCHASE CONTRACTS

- A. General: Owner has negotiated purchase contracts with suppliers of material and equipment to be incorporated into the Work. Owner will assign these purchase contracts to Contractor. Include costs for purchasing, receiving, handling, storage if required, and installation of material and equipment in the Contract Sum, unless otherwise indicated.
 1. Contractor's responsibilities are same as if Contractor had negotiated purchase contracts, including responsibility to renegotiate purchase and to execute final purchasing agreements.

1.7 OWNER-FURNISHED PRODUCTS

- A. Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products and making building services connections.
 1. The precast concrete panels will be Owner provided, Contractor installed. Enterprise Preast will be awarded the precast panels with a tentative availability of March 16, 2026.
 2. The fluid cooler will be Owner provided, Contractor installed. Data Power will be awarded the Marely Fluid Cooler with a tentative delivery date of May 1, 2026.

1.8 ACCESS TO SITE

- A. General: Contractor shall have limited use of Project site for construction operations. The Owner will be occupying the building during construction. Coordinate access to the site and limits of construction with Owner and as indicated by requirements of this Section.
- B. 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 project site and property.
 - 2. Limits: Limit site disturbance, including earthwork and clearing of vegetation, to 25 feet beyond building perimeter; 10 feet beyond surface walkways, patios, surface parking, and utilities less than 12 inches in diameter; 15 feet beyond primary roadway curbs and main utility branch trenches; and 25 feet beyond constructed areas with permeable surfaces (such as pervious paving areas, stormwater detention facilities, and playing fields) that require additional staging areas in order to limit compaction in the constructed area.
 - 3. Driveways, Walkways and Entrances: Keep driveways loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Provide site and phasing plan to Owner prior a minimum of 30 days before commencement of work.
 - b. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - c. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. 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.

1.9 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7:00 a.m. to 6:00 p.m., Monday through Friday, unless otherwise indicated.
 - 1. Weekend Hours: As approved by Owner with 72 hour advanced notification.
 - 2. Early Morning Hours: Not allowed.
 - 3. Hours for Utility Shutdowns: As approved by Owner with 10 working days advanced notification.
 - 4. Hours for Insert noisy activity: 7:30 a.m. to 6:00 p.m.
- C. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.
- A. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.
- B. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times. All tags to be issued by One Source Badging. See One Source Setup Form included in project manual.
- C. Employee Screening: Comply with Owner's requirements for background screening of Contractor personnel working on Project site. All tags to be issued by One Source Badging. See One Source Setup Form included in project manual.

1. Maintain list of approved screened personnel with Owner's representative.

1.10 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 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 60 00 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

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 cannot be provided, if applicable.
 - b. Coordination 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 substitution 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 and 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. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitution 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.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. 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.
 - m. 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 through Construction Manager 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.

PART 2 - PRODUCTS

2.1 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. Requested substitution provides sustainable design characteristics that specified product provided.
 - c. Substitution request is fully documented and properly submitted.
 - d. Requested substitution will not adversely affect Contractor's construction schedule.

- e. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - f. Requested substitution is compatible with other portions of the Work.
 - g. Requested substitution has been coordinated with other portions of the Work.
 - h. Requested substitution provides specified warranty.
 - i. 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 unless otherwise indicated.
- C. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.
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 offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Requested substitution provides sustainable design characteristics that specified product provided.
 - e. Substitution request is fully documented and properly submitted.
 - f. Requested substitution will not adversely affect Contractor's construction schedule.
 - g. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - h. Requested substitution is compatible with other portions of the Work.
 - i. Requested substitution has been coordinated with other portions of the Work.
 - j. Requested substitution provides specified warranty.
 - k. 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.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

SUBSTITUTION REQUEST FORM

To: TACKarchitects
2922 N 61st Street, Studio 1
Omaha, Nebraska 68104
Project: Westside High School Cooling Tower

Project No.: 2025.016.00 Date Received: _____

Specification Section Number and Paragraphs: _____

Drawings and Details Affected: _____

Proposed Substitution: _____

Manufacturer: _____

Product (Model, Pattern, etc.): _____

WHY IS SUBSTITUTION BEING SUBMITTED? *(Select One of the Following)*

- ☐ Voluntary Alternate
☐ Specified Product is Not Available – Explain
☐ Cost Savings to Owner – Indicate Comparative Cost Analysis
☐ Other – Explain

EFFECTS OF PROPOSED SUBSTITUTION (Answer the Following Questions and Attach Explanations)

Does substitution affect dimensions indicated on the Drawings?
(NO) (YES, explain)

Does substitution affect work of other sections?
(NO) (YES, explain)

Does substitution require modifications to design, change to Drawings, or revisions to specifications to be incorporated into the project?
(NO) (YES, explain)

Attach list of at least three projects where proposed substitution has been used within past 12 months.
Include name, address, and telephone number of Owner and Architect.

CONTRACTOR'S / BIDDER'S REPRESENTATION

Undersigned accepts responsibility for coordination of proposed substitution and accepts all additional costs resulting from the incorporation of proposed substitution into the project per Section 01 60 00.

SUBMITTED BY:

For Architect's Use:

Accepted (___) Not Accepted (___)

No Action Required (___)

Submission: Incomplete (___) Too Late (___)

Reviewed By/Date: _____

Comments _____

Subcontractor's Signature and Date: _____

Contractor's Signature and Date: _____

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 through Construction Manager supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

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 or Construction Manager are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 10 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.
 - 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 Construction Manager.

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 approval of a Work Changes Proposal Request, Construction Manager will issue a Change Order for signatures of Construction Manager and Subcontractor-

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Construction Manager 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.

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 other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect through Construction Manager at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
 - 3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
 - 4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
 - 5. Subschedules for Separate Design Contracts: Where the Owner has retained design professionals under separate contracts who will each provide certification of payment requests, provide subschedules showing values coordinated with the scope of each design services contract as described in Section 01 10 00 "Summary."

- 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.
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.
 - 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. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
 - a. 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.
 5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 6. 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. If required, include evidence of insurance.
 7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
 8. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
 9. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate owner payments or deposits, if any, and balance to be paid by Contractor.
 10. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

- a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
- 11. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

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 Construction Manager and paid for by Owner.
 - 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- 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. Payment Application Times: Submit Application for Payment to Architect by the last of the month. The period covered by each Application for Payment is one month, ending on the last day of the month. Subcontractors to submit application for payment to Construction Manager by the 25th day of the month.
 - 1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment. Subcontractors to use G702 and G703 for billings to the Construction Manager. Submit forms for approval with initial submittal of schedule of values.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Construction Manager 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.
- F. 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.
- G. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Construction Manager 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.
- H. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
 - 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. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- I. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens 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.
- J. 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. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 - 5. Products list (preliminary if not final).
 - 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.
- K. 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.

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.
- L. 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, "Contractor's Affidavit of Payment of Debts and Claims."
 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 6. AIA Document G707, "Consent of Surety to Final Payment."
 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 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. Requests for Information (RFIs).
 - 4. Project Web site.
 - 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 32 00 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Section 01 73 00 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Section 01 77 00 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. RFI: Request from Owner, Construction Manager, 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, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone

numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in project meeting room, in temporary field office, on Project Web site, and by each temporary telephone. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. 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 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.
- D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors 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.
- E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.

- c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
- 8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
- 9. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
- 10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01 33 00 "Submittal Procedures."

1.7 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 - 1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
 - 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 - 1. Project name.
 - 2. Project number.
 - 3. Date.
 - 4. Name of Contractor.
 - 5. Name of Architect and Construction Manager.
 - 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: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
 - 1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- D. Architect's and Construction Manager's Action: Architect and Construction Manager will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect or Construction Manager after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and Construction Manager in writing within 10 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use software log that is part of Project Web site. Include the following:
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect and Construction Manager.
 4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's and Construction Manager's response was received.
- F. On receipt of Architect's and Construction Manager's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect and Construction Manager within seven days if Contractor disagrees with response.
1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.8 PROJECT WEB SITE

- A. Provide access to a Project Web site for purposes of hosting and managing project communication and documentation until Final Completion. Project Web site shall include the following functions:
1. Project directory.
 2. Project correspondence.
 3. Meeting minutes.
 4. Contract modifications forms and logs.
 5. RFI forms and logs.
 6. Task and issue management.
 7. Photo documentation.
 8. Schedule and calendar management.
 9. Submittals forms and logs.
 10. Payment application forms.
 11. Drawing and specification document hosting, viewing, and updating.

12. Online document collaboration.
13. Reminder and tracking functions.
14. Archiving functions.

- B. On completion of Project, provide one complete archive copy(ies) of Project Web site files to Owner and to Architect in a digital storage format acceptable to Architect.
- C. Contractor, subcontractors, and other parties granted access by Contractor to Project Web site shall execute a data licensing agreement in the form of Agreement acceptable to Owner and Architect.

1.9 PROJECT MEETINGS

- A. General: Construction Manager will 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.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, Construction Manager, and Architect, within three days of the meeting.
- B. Preconstruction Conference: Construction Manager will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
 1. Conduct the conference to review responsibilities and personnel assignments.
 2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, , Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Lines of communications.
 - f. Procedures for processing field decisions and Change Orders.
 - g. Procedures for RFIs.
 - h. Procedures for testing and inspecting.
 - i. Procedures for processing Applications for Payment.
 - j. Distribution of the Contract Documents.
 - k. Submittal procedures.
 - l. Preparation of record documents.
 - m. Use of the premises and existing building.
 - n. Work restrictions.
 - o. Working hours.
 - p. Owner's occupancy requirements.
 - q. Responsibility for temporary facilities and controls.
 - r. Procedures for moisture and mold control.
 - s. Procedures for disruptions and shutdowns.
 - t. Construction waste management and recycling.
 - u. Parking availability.
 - v. Office, work, and storage areas.

- w. Equipment deliveries and priorities.
- x. First aid.
- y. Security.
- z. Progress cleaning.

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

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, Construction Manager, and Owner's Commissioning Authority of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

- a. Contract Documents.
- b. Options.
- c. Related RFIs.
- d. Related Change Orders.
- e. Purchases.
- f. Deliveries.
- g. Submittals.
- h. Review of mockups.
- i. Possible conflicts.
- j. Compatibility requirements.
- k. Time schedules.
- l. Weather limitations.
- m. Manufacturer's written instructions.
- n. Warranty requirements.
- o. Compatibility of materials.
- p. Acceptability of substrates.
- q. Temporary facilities and controls.
- r. Space and access limitations.
- s. Regulations of authorities having jurisdiction.
- t. Testing and inspecting requirements.
- u. Installation procedures.
- v. Coordination with other work.
- w. Required performance results.
- x. Protection of adjacent work.
- y. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Construction Manager will schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.

2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of record documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Submittal of written warranties.
 - d. Requirements for preparing operations and maintenance data.
 - e. Requirements for delivery of material samples, attic stock, and spare parts.
 - f. Requirements for demonstration and training.
 - g. Preparation of Contractor's punch list.
 - h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - i. Submittal procedures.
 - j. Coordination of separate contracts.
 - k. Owner's partial occupancy requirements.
 - l. Installation of Owner's furniture, fixtures, and equipment.
 - m. Responsibility for removing temporary facilities and controls.
4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: Construction Manager will conduct progress meetings at regular intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority, Construction Manager, 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.
 - 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) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site utilization.
 - 9) Temporary facilities and controls.
 - 10) Progress cleaning.
 - 11) Quality and work standards.

- 12) Status of correction of deficient items.
 - 13) Field observations.
 - 14) Status of RFIs.
 - 15) Status of proposal requests.
 - 16) Pending changes.
 - 17) Status of Change Orders.
 - 18) Pending claims and disputes.
 - 19) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- F. Coordination Meetings: Construction Manager will conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority, Construction Manager, 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 meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined 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.
 - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site utilization.
 - 9) Temporary facilities and controls.
 - 10) Work hours.
 - 11) Hazards and risks.
 - 12) Progress cleaning.
 - 13) Quality and work standards.
 - 14) Change Orders.
 3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

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 documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's construction schedule.
 - 3. Construction schedule updating reports.
 - 4. Daily construction reports.
 - 5. Material location reports.
 - 6. Site condition reports.
 - 7. Special reports.
- B. Related Requirements:
 - 1. Section 01 33 00 "Submittal Procedures" for submitting schedules and reports.
 - 2. Section 01 40 00 "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Architect.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.

1. Float time belongs to Owner.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

- G. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file, where indicated.
2. PDF electronic file.

- B. Startup construction schedule.

1. Approval of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

- C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

- E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
3. Total Float Report: List of all activities sorted in ascending order of total float.
4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.

- F. Construction Schedule Updating Reports: Submit with Applications for Payment.

- G. Daily Construction Reports: Submit at weekly intervals.

- H. Material Location Reports: Submit at weekly intervals.

- I. Site Condition Reports: Submit at time of discovery of differing conditions.

- J. Special Reports: Submit at time of unusual event.

- K. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

- A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.
- B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
 - 1. Review software limitations and content and format for reports.
 - 2. Verify availability of qualified personnel needed to develop and update schedule.
 - 3. Discuss constraints, including phasing, work stages, area separations, interim milestones, and partial Owner occupancy.
 - 4. Review delivery dates for Owner-furnished products.
 - 5. Review schedule for work of Owner's separate contracts.
 - 6. Review submittal requirements and procedures.
 - 7. Review time required for review of submittals and resubmittals.
 - 8. Review requirements for tests and inspections by independent testing and inspecting agencies.
 - 9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
 - 10. Review and finalize list of construction activities to be included in schedule.
 - 11. Review procedures for updating schedule.

1.6 COORDINATION

- A. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 - 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - 3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.

4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's and Construction Manager's administrative procedures necessary for certification of Substantial Completion.
 6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
 2. Work under More Than One Contract: Include a separate activity for each contract.
 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 6. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
 7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Building flush-out.
 - m. Startup and placement into final use and operation.
 8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.
 - e. Completion of electrical installation.
 - f. Substantial Completion.

- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.
- E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 - 1. Unresolved issues.
 - 2. Unanswered Requests for Information.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
 - 5. Pending modifications affecting the Work and Contract Time.
- F. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.
- G. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

2.2 STARTUP CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit startup, horizontal, bar-chart-type construction schedule within seven days of date established for the Notice of Award.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 30 days of date established for the Notice of Award. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
 - 1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

2.4 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 - 1. List of subcontractors at Project site.
 - 2. List of separate contractors at Project site.
 - 3. Approximate count of personnel at Project site.
 - 4. Equipment at Project site.
 - 5. Material deliveries.
 - 6. High and low temperatures and general weather conditions, including presence of rain or snow.

7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (see special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorized.

- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.

- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.5 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate final completion percentage for each activity.

- B. Distribution: Distribute copies of approved schedule to Architect, Construction Manager, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 01 32 00

SECTION 01 32 33 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Periodic construction photographs.
 - 3. Final completion construction photographs.
- B. Related Requirements:
 - 1. Section 01 33 00 "Submittal Procedures" for submitting photographic documentation.
 - 2. Section 01 77 00 "Closeout Procedures" for submitting photographic documentation as project record documents at Project closeout.
 - 3. Section 01 79 00 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
 - 4. Section 02 41 19 "Selective Structure Demolition" for photographic documentation before selective demolition operations commence.

1.3 INFORMATIONAL SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within three days of taking photographs.
 - 1. Digital Camera: Minimum sensor resolution of 8 megapixels.
 - 2. Format: Minimum 3200 by 2400 pixels, in unaltered original files, with same aspect ratio as the sensor, uncropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.
 - 3. Identification: Provide the following information with each image description in file metadata tag:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect and Construction Manager.
 - d. Name of Contractor.
 - e. Date photograph was taken.
 - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - g. Unique sequential identifier keyed to accompanying key plan.

1.4 USAGE RIGHTS

- A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

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

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
 - 1. Date and Time: Include date and time in file name for each image.
 - 2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect and Construction Manager.
- C. Preconstruction Photographs: Before commencement of excavation, commencement of demolition, starting construction, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect and Construction Manager.
 - 1. Flag excavation areas and construction limits before taking construction photographs.
 - 2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
 - 3. Take 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
 - 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- D. Periodic Construction Photographs: Take 20 photographs weekly, with timing each month adjusted to coincide with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- E. Architect-Directed Construction Photographs: From time to time, Architect will instruct photographer about number and frequency of photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.
- F. Final Completion Construction Photographs: Take 20 color photographs after date of Substantial Completion for submission as project record documents. Architect will inform photographer of desired vantage points.

1. Do not include date stamp.

G. Additional Photographs: Architect may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum or in the allowance for construction photographs.

1. Three days' notice will be given, where feasible.
2. In emergency situations, take additional photographs within 24 hours of request.
3. Circumstances that could require additional photographs include, but are not limited to, the following:
 - a. Special events planned at Project site.
 - b. Immediate follow-up when on-site events result in construction damage or losses.
 - c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
 - d. Substantial Completion of a major phase or component of the Work.
 - e. Extra record photographs at time of final acceptance.
 - f. Owner's request for special publicity photographs.

END OF SECTION 01 32 33

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Requirements:
 - 1. Section 01 29 00 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. Section 01 32 00 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 3. Section 01 78 23 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 4. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 5. 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 and Construction Manager'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 and Construction Manager's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and Construction Manager and additional time for handling and reviewing submittals required by those corrections.
 - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.

2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's and Construction Manager's final release or approval.
 - g. Scheduled date of fabrication.
 - h. Scheduled dates for purchasing.
 - i. Scheduled dates for installation.
 - j. Activity or event number.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will[**not**] be provided by Architect for Contractor's use in preparing submittals.
 1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings.
 - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
 - b. Digital Drawing Software Program: The Contract Drawings are available in AutoCAD 2022.
 - c. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.
 - d. The following digital data files will be furnished for each appropriate discipline:
 - 1) Floor plans.
 - 2) Reflected ceiling plans.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect and Construction Manager reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 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 15 days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
 5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
- D. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect and Construction Manager.
 4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Name of firm or entity that prepared submittal.
 - g. Names of subcontractor, manufacturer, and supplier.
 - h. Category and type of submittal.
 - i. Submittal purpose and description.
 - j. Specification Section number and title.
 - k. Specification paragraph number or drawing designation and generic name for each of multiple items.
 - l. Drawing number and detail references, as appropriate.
 - m. Location(s) where product is to be installed, as appropriate.
 - n. Related physical samples submitted directly.
 - o. Indication of full or partial submittal.
 - p. Transmittal number, numbered consecutively.
 - q. Submittal and transmittal distribution record.
 - r. Other necessary identification.
 - s. Remarks.
- E. Options: Identify options requiring selection by Architect.
- F. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect and Construction Manager

on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

- G. 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 and Construction Manager's action stamp.
- H. 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.
- I. 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 and Construction Manager's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Post electronic submittals as PDF electronic files directly to Project Web site specifically established for Project.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 - 2. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:
 - a. PDF electronic file.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
 3. Submit Shop Drawings in the following format:
 - a. PDF electronic file.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
 - e. Specification paragraph number and generic name of each item.
 3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.

- b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
- 5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
- 6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect and Construction Manager will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 - 1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 - 2. Manufacturer and product name, and model number if applicable.
 - 3. Number and name of room or space.
 - 4. Location within room or space.
 - 5. Submit product schedule in the following format:
 - a. PDF electronic file.
- F. Coordination Drawing Submittals: Comply with requirements specified in Section 01 31 00 "Project Management and Coordination."
- G. Contractor's Construction Schedule: Comply with requirements specified in Section 01 32 00 "Construction Progress Documentation."
- H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 01 29 00 "Payment Procedures."
- I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 40 00 "Quality Requirements."
- J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 77 00 "Closeout Procedures."
- K. Maintenance Data: Comply with requirements specified in Section 01 78 23 "Operation and Maintenance Data."

- L. 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.
- M. 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.
- N. 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.
- O. 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.
- P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- R. 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.
- S. 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.
- T. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- U. 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.
- V. 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.
- W. 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.
- X. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect and Construction Manager.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Section 01 77 00 "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S AND CONSTRUCTION MANAGER'S ACTION

- A. Action Submittals: Architect and Construction Manager will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect and Construction Manager will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- B. Informational Submittals: Architect and Construction Manager will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect and Construction Manager 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 and Construction Manager.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 01 33 00

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.
 - 4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
 - 1. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 ACTION SUBMITTALS

- A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.
 - 1. Indicate manufacturer and model number of individual components.
 - 2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data : For Contractor's quality-control personnel.
- C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.

4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

1.7 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 1. Date of issue.
 2. Project title and number.
 3. Name, address, and telephone number of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
 1. Name, address, and telephone number of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
 1. Name, address, and telephone number of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.
- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.8 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
 - 2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 - 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
 - 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.

6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 7. Demolish and remove mockups when directed unless otherwise indicated.
- K. Integrated Exterior Mockups: Construct integrated exterior mockup according to approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.

1.9 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
 3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 33 00 "Submittal Procedures."
- D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

- F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.10 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 - 1. Date test or inspection was conducted.
 - 2. Description of the Work tested or inspected.
 - 3. Date test or inspection results were transmitted to Architect.
 - 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 01 42 00 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. AABC - Associated Air Balance Council; www.aabc.com.
 2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
 3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
 4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
 5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
 6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
 7. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org.
 8. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
 9. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
 10. AF&PA - American Forest & Paper Association; www.afandpa.org.
 11. AGA - American Gas Association; www.aga.org.
 12. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
 13. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
 14. AI - Asphalt Institute; www.asphaltinstitute.org.
 15. AIA - American Institute of Architects (The); www.aia.org.
 16. AISC - American Institute of Steel Construction; www.aisc.org.
 17. AISI - American Iron and Steel Institute; www.steel.org.
 18. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
 19. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
 20. ANSI - American National Standards Institute; www.ansi.org.
 21. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
 22. APA - APA - The Engineered Wood Association; www.apawood.org.
 23. APA - Architectural Precast Association; www.archprecast.org.
 24. API - American Petroleum Institute; www.api.org.
 25. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
 26. ARI - American Refrigeration Institute; (See AHRI).
 27. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
 28. ASCE - American Society of Civil Engineers; www.asce.org.
 29. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
 30. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
 31. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
 32. ASSE - American Society of Safety Engineers (The); www.asse.org.
 33. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
 34. ASTM - ASTM International; (American Society for Testing and Materials International); www.astm.org.
 35. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
 36. AWEA - American Wind Energy Association; www.awea.org.
 37. AWI - Architectural Woodwork Institute; www.awinet.org.
 38. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
 39. AWPA - American Wood Protection Association; (Formerly: American Wood-Preservers' Association); www.awpa.com.
 40. AWS - American Welding Society; www.aws.org.
 41. AWWA - American Water Works Association; www.awwa.org.
 42. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
 43. BIA - Brick Industry Association (The); www.gobrick.com.
 44. BICSI - BICSI, Inc.; www.bicsi.org.

45. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.com.
46. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
47. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bwfbadminton.org.
48. CDA - Copper Development Association; www.copper.org.
49. CEA - Canadian Electricity Association; www.electricity.ca.
50. CEA - Consumer Electronics Association; www.ce.org.
51. CFFA - Chemical Fabrics & Film Association, Inc.; www.chemicalfabricsandfilm.com.
52. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
53. CGA - Compressed Gas Association; www.cganet.com.
54. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
55. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
56. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
57. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
58. CPA - Composite Panel Association; www.pbmdf.com.
59. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
60. CRRRC - Cool Roof Rating Council; www.coolroofs.org.
61. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
62. CSA - Canadian Standards Association; www.csa.ca.
63. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
64. CSI - Construction Specifications Institute (The); www.csinet.org.
65. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
66. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
67. CWC - Composite Wood Council; (See CPA).
68. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
69. DHI - Door and Hardware Institute; www.dhi.org.
70. ECA - Electronic Components Association; (See ECIA).
71. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
72. ECIA ? Electronic Components Industry Association; www.eciaonline.org
73. EIA - Electronic Industries Alliance; (See TIA).
74. EIMA - EIFS Industry Members Association; www.eima.com.
75. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
76. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org.
77. ESTA - Entertainment Services and Technology Association; (See PLASA).
78. EVO - Efficiency Valuation Organization; www.evo-world.org.
79. FIBA - F?d?ration Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
80. FIVB - F?d?ration Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
81. FM Approvals - FM Approvals LLC; www.fmglobal.com.
82. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
83. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridarroof.com.
84. FSA - Fluid Sealing Association; www.fluidsealing.com.
85. FSC - Forest Stewardship Council U.S.; www.fscus.org.
86. GA - Gypsum Association; www.gypsum.org.
87. GANA - Glass Association of North America; www.glasswebsite.com.
88. GS - Green Seal; www.greenseal.org.
89. HI - Hydraulic Institute; www.pumps.org.
90. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
91. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
92. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
93. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
94. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
95. IAS - International Accreditation Service; www.iasonline.org.
96. IAS - International Approval Services; (See CSA).
97. ICBO - International Conference of Building Officials; (See ICC).
98. ICC - International Code Council; www.iccsafe.org.

99. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
100. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
101. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
102. IEC - International Electrotechnical Commission; www.iec.ch.
103. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
104. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
105. IESNA - Illuminating Engineering Society of North America; (See IES).
106. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
107. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
108. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
109. ILI - Indiana Limestone Institute of America, Inc.; www.ili.ai.com.
110. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
111. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
112. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
113. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
114. ISO - International Organization for Standardization; www.iso.org.
115. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
116. ITU - International Telecommunication Union; www.itu.int/home.
117. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
118. LMA - Laminating Materials Association; (See CPA).
119. LPI - Lightning Protection Institute; www.lightning.org.
120. MBMA - Metal Building Manufacturers Association; www.mbma.com.
121. MCA - Metal Construction Association; www.metalconstruction.org.
122. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
123. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
124. MHIA - Material Handling Industry of America; www.mhia.org.
125. MIA - Marble Institute of America; www.marble-institute.com.
126. MMPA - Moulding & Millwork Producers Association; (Formerly: Wood Moulding & Millwork Producers Association); www.wmmpa.com.
127. MPI - Master Painters Institute; www.paintinfo.com.
128. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
129. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
130. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
131. NADCA - National Air Duct Cleaners Association; www.nadca.com.
132. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
133. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
134. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
135. NCMA - National Concrete Masonry Association; www.ncma.org.
136. NEBB - National Environmental Balancing Bureau; www.nebb.org.
137. NECA - National Electrical Contractors Association; www.necanet.org.
138. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
139. NEMA - National Electrical Manufacturers Association; www.nema.org.
140. NETA - InterNational Electrical Testing Association; www.netaworld.org.
141. NFHS - National Federation of State High School Associations; www.nfhs.org.
142. NFPA - NFPA; (National Fire Protection Association); www.nfpa.org.
143. NFPA - NFPA International; (See NFPA).
144. NFRC - National Fenestration Rating Council; www.nfrc.org.
145. NHLA - National Hardwood Lumber Association; www.nhla.com.
146. NLGA - National Lumber Grades Authority; www.nlga.org.
147. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
148. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
149. NRCA - National Roofing Contractors Association; www.nrca.net.
150. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.

151. NSF - NSF International; (National Sanitation Foundation International); www.nsf.org.
152. NSPE - National Society of Professional Engineers; www.nspe.org.
153. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
154. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
155. NWFA - National Wood Flooring Association; www.nwfa.org.
156. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
157. PDI - Plumbing & Drainage Institute; www.pdionline.org.
158. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
159. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
160. RFCI - Resilient Floor Covering Institute; www.rfci.com.
161. RIS - Redwood Inspection Service; www.redwoodinspection.com.
162. SAE - SAE International; (Society of Automotive Engineers); www.sae.org.
163. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
164. SDI - Steel Deck Institute; www.sdi.org.
165. SDI - Steel Door Institute; www.steeldoor.org.
166. SEFA - Scientific Equipment and Furniture Association; www.sefalabs.com.
167. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
168. SIA - Security Industry Association; www.siaonline.org.
169. SJI - Steel Joist Institute; www.steeljoist.org.
170. SMA - Screen Manufacturers Association; www.smainfo.org.
171. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
172. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
173. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
174. SPIB - Southern Pine Inspection Bureau; www.spib.org.
175. SPRI - Single Ply Roofing Industry; www.spri.org.
176. SRCC - Solar Rating and Certification Corporation; www.solar-rating.org.
177. SSINA - Specialty Steel Industry of North America; www.ssina.com.
178. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
179. STI - Steel Tank Institute; www.steeltank.com.
180. SWI - Steel Window Institute; www.steelwindows.com.
181. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
182. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
183. TCNA - Tile Council of North America, Inc.; (Formerly: Tile Council of America); www.tileusa.com.
184. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
185. TIA - Telecommunications Industry Association; (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
186. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
187. TMS - The Masonry Society; www.masonrysociety.org.
188. TPI - Truss Plate Institute; www.tpinst.org.
189. TPI - Turfgrass Producers International; www.turfgrasssod.org.
190. TRI - Tile Roofing Institute; (Formerly: National Tile Roofing Manufacturing Association); www.tilerroofing.org.
191. UBC - Uniform Building Code; (See ICC).
192. UL - Underwriters Laboratories Inc.; www.ul.com.
193. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
194. USAV - USA Volleyball; www.usavolleyball.org.
195. USGBC - U.S. Green Building Council; www.usgbc.org.
196. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
197. WASTEC - Waste Equipment Technology Association; www.wastec.org.
198. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
199. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
200. WDMA - Window & Door Manufacturers Association; www.wdma.com.
201. WI - Woodwork Institute; (Formerly: WIC - Woodwork Institute of California); www.wicnet.org.
202. WMPMA - Wood Moulding & Millwork Producers Association; (See MPPA).
203. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
204. WPA - Western Wood Products Association; www.wwpa.org.

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

1. DIN - Deutsches Institut für Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.
5. <http://txforestservation.tamu.edu>.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 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 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- D. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.
 - 1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
 - 2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
 - 3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
- 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. Identify further options if proposed measures are later determined to be inadequate. 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.
- C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.6 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top rails.
- B. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.
- C. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches.
- D. 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 TEMPORARY FACILITIES

- A. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 1. Store combustible materials apart from building.

2.3 EQUIPMENT

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

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: existing.
- C. Water Service: existing.
- D. Sanitary Facilities: existing.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. 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 according to coordination drawings.
 - 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.

- G. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
 - 1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- H. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Install electric power service underground unless otherwise indicated.
 - 2. Connect temporary service to Owner's existing power source, as directed by Owner.
- I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 - 2. Install lighting for Project identification sign.

3.2 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
 - 2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Coordinate the locate temporary roads and paved areas with Owner.
 - 1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- C. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
 - 1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 - 2. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
- D. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- E. Parking: Use designated areas of Owner's existing parking areas for construction personnel. A limited number of stalls will be available. Coordinate number of stalls available and exact location with Owner prior to commencement of construction.

- F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.
- G. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 - 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 - 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 - 3. Maintain and touchup signs so they are legible at all times.
- H. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 01 73 00 "Execution."
- I. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
 - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.3 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Comply with work restrictions specified in Section 01 10 00 "Summary."
- C. Temporary Erosion and Sedimentation Control: Comply with requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified on drawings.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations. Coordinate exact extent of fence with Owner.
 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.
- I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- J. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- L. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner and tenants from fumes and noise.
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 polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches 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 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.
- M. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
1. Prohibit smoking in construction areas.
 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.4 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 - 1. Protect porous materials from water damage.
 - 2. Protect stored and installed material from flowing or standing water.
 - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 - 4. Remove standing water from decks.
 - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 - 2. Keep interior spaces reasonably clean and protected from water damage.
 - 3. Periodically collect and remove waste containing cellulose or other organic matter.
 - 4. Discard or replace water-damaged material.
 - 5. Do not install material that is wet.
 - 6. Discard, replace, or clean stored or installed material that begins to grow mold.
 - 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
 - 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 - 2. Use permanent HVAC system to control humidity.
 - 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove materials that can not be completely restored to their manufactured moisture level within 48 hours.

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.

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. Operate Project-identification-sign lighting daily from dusk until 12:00 midnight.
- D. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- E. 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 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 01 25 00 "Substitution Procedures" for requests for substitutions.
 - 2. Section 01 42 00 "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor through

Construction Manager of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

- a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
- b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
 1. 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, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
 1. Store products to allow for inspection and measurement of quantity or counting of units.
 2. Store materials in a manner that will not endanger Project structure.
 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 6. Protect stored products from damage and liquids from freezing.
 7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01 77 00 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 - 4. Where products are accompanied by the term "as selected," Architect will make selection.
 - 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 - 6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
 - 1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - 2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - 3. Products:

- a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
 - b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
- 4. Manufacturers:
 - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
 - b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
- 5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
- C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 - 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01 25 00 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

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

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 60 00

SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner-installed products.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for limits on use of Project site.
 - 2. Section 01 33 00 "Submittal Procedures" for submitting surveys.
 - 3. Section 01 77 00 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.3 DEFINITIONS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.
- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- C. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
 - 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.

3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.

- a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

- D. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.5 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Mechanical systems piping and ducts.
 - f. Control systems.
 - g. Communication systems.
 - h. Fire-detection and -alarm systems.
 - i. Conveying systems.
 - j. Electrical wiring systems.
 - k. Operating systems of special construction.
 3. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- B. 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.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - 1. Description of the Work.
 - 2. List of detrimental conditions, including substrates.
 - 3. List of unacceptable installation tolerances.
 - 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

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

- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 01 31 00 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect and Construction Manager promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect and Construction Manager when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect and Construction Manager.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect or Construction Manager. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect and Construction Manager before proceeding.

2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.
 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

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

3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."
- F. 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.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 4. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 OWNER-INSTALLED PRODUCTS

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

3.8 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 50 00 "Temporary Facilities and Controls."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 01 91 13 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 73 00

SECTION 01 77 00 - CLOSEOUT 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 contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
- B. Related Requirements:
 - 1. Section 01 32 33 "Photographic Documentation" for submitting final completion construction photographic documentation.
 - 2. Section 01 73 00 "Execution" for progress cleaning of Project site.
 - 3. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 4. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 5. Section 01 79 00 "Demonstration and Training" for requirements for instructing Owner's personnel.

1.3 ACTION SUBMITTALS

- A. Product Data: For cleaning agents.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

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

1.6 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
 - 5. Submit test/adjust/balance records.
 - 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Advise Owner of pending insurance changeover requirements.
 - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 3. Complete startup and testing of systems and equipment.
 - 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 - 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
 - 6. Advise Owner of changeover in heat and other utilities.
 - 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 - 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 - 9. Complete final cleaning requirements, including touchup painting.
 - 10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on

Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

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

1.7 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect and Construction Manager.
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in the following format:
 - a. PDF electronic file. Architect, through Construction Manager, will return annotated file.

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
 - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
 - 4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

- a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
- b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
- c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
- d. Remove tools, construction equipment, machinery, and surplus material from Project site.
- e. Remove snow and ice to provide safe access to building.
- f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
- g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
- h. Sweep concrete floors broom clean in unoccupied spaces.
- i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
- j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
- k. Remove labels that are not permanent.
- l. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
- p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
- q. Leave Project clean and ready for occupancy.

- C. Pest Control: Comply with pest control requirements in Section 01 50 00 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste disposal requirements in Section 01 50 00 "Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
 - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.

- a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 01 77 00

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.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.
- B. Related Requirements:
 - 1. Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

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

1.4 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect and Commissioning Authority will comment on whether content of operations and maintenance submittals are acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
 - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.

- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
 - 1. List of documents.
 - 2. List of systems.
 - 3. List of equipment.
 - 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.

3. Name and address of Owner.
 4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Construction Manager.
 7. Name and contact information for Architect.
 8. Name and contact information for Commissioning Authority.
 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
 4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.

- b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
 1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
 1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.
 4. Required sequences for electric or electronic systems.
 5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 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.

- B. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUALS

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Product Information: Include the following, as applicable:
1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.

- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 1. Do not use original project record documents as part of operation and maintenance manuals.
 2. Comply with requirements of newly prepared record Drawings in Section 017839 "Project Record Documents."
- G. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

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 73 00 "Execution" for final property survey.
 - 2. Section 01 77 00 "Closeout Procedures" for general closeout procedures.
 - 3. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set(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 PDF electronic files of scanned record prints and three set(s) of prints.
 - 2) Print each drawing, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit one paper copy and an annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

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

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

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

2.2 RECORD SPECIFICATIONS

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

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

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

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, record Specifications, and record Drawings where applicable.

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

1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as scanned PDF electronic file(s) of marked-up miscellaneous record submittals.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss.

Provide access to project record documents for Architect's and Construction Manager's reference during normal working hours.

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. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.

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.
- 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 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. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 - 1. Inspect and discuss locations and other facilities required for instruction.
 - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 - 3. Review required content of instruction.
 - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION

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

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 - 4. Operations: Include the following, as applicable:

- a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
- a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

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

END OF SECTION 01 79 00

SECTION 034500 - PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Architectural precast concrete load-bearing units.

1.2 DEFINITIONS

- A. Design Reference Sample: Sample of approved architectural precast concrete color, finish and texture, preapproved by Architect.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.
- C. Shop Drawings:
 - 1. Detail fabrication and installation of architectural precast concrete units.
 - 2. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit.
 - 3. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.
 - 4. Indicate details at building corners.
- D. Samples: Design reference samples for initial verification of design intent, for each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of three, representative of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches. Include one sample with smooth finish and one with the brick inlay.
- E. Delegated-Design Submittal: For architectural precast concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Material certificates.
- C. Material Test Reports: For aggregates.

- D. Field quality-control and special inspection reports.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
 - 1. Designated as a PCI-certified plant for Group A, Category A1 - Architectural Cladding and Load Bearing Units or designated as an APA-certified plant for production of architectural precast concrete products.
- B. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D.1.1M, "Structural Welding Code - Steel"; and AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

1.7 COORDINATION

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer to design architectural precast concrete units.
- B. Design Standards: Comply with ACI 318 and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.
- C. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding design loads indicated within limits and under conditions indicated.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A706/A706M, deformed.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A185/A185M, fabricated from galvanized-steel wire into flat sheets.
- D. Deformed-Steel Welded Wire Reinforcement: ASTM A497/A497M, flat sheet.
- E. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

2.3 PRESTRESSING TENDONS

- A. Prestressing Strand: ASTM A416/A416M, Grade 270, uncoated, seven-wire, low-relaxation strand.
 - 1. Coat unbonded post-tensioning strand with post-tensioning coating complying with ACI 423.7 and sheath with polypropylene tendon sheathing complying with ACI 423.7. Include anchorage devices and coupler assemblies.

2.4 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or Type III, gray, unless otherwise indicated.
 - 1. For surfaces exposed to view in finished structure, use gray or white cement, of same type, brand, and mill source.
- B. Supplementary Cementitious Materials:
 - 1. Metakaolin: ASTM C618, Class N.
 - 2. Silica Fume: ASTM C1240, with optional chemical and physical requirement.
 - 3. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.
- C. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C33/C33M, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
 - 1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
 - a. Gradation: To match design reference sample.
 - 2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand compatible with coarse aggregate; to match approved finish sample.
- D. Coloring Admixture: ASTM C979/C979M, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.
- E. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.
- F. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.
- G. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

2.5 STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A36/A36M.
- B. Carbon-Steel-Headed Studs: ASTM A108, AISI 1018 through AISI 1020, cold finished, AWS D1.1/D1.1M, Type A or Type B, with arc shields and with minimum mechanical properties of PCI MNL 117, Table 3.2.3.
- C. Carbon-Steel Plate: ASTM A283/A283M, Grade C.
- D. Malleable Iron Castings: ASTM A47/A47M, Grade 32510 or Grade 35028.

- E. Carbon-Steel Castings: ASTM A27/A27M, Grade 60-30.
- F. High-Strength, Low-Alloy Structural Steel: ASTM A572/A572M.
- G. Carbon-Steel Structural Tubing: ASTM A500/A500M, Grade B or Grade C.
- H. Wrought Carbon-Steel Bars: ASTM A675/A675M, Grade 65.
- I. Deformed-Steel Wire or Bar Anchors: ASTM A496/A496M or ASTM A706/A706M.
- J. Carbon-Steel Bolts and Studs: ASTM A307, Grade A or ASTM F1554, Grade 36; carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A563; and flat, unhardened steel washers, ASTM F844.
- K. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
- L. Zinc-Coated Finish: For exterior steel items, steel in exterior walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A123/A123M or ASTM A153/A153M.
 - 1. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035B or SSPC-Paint 20.

2.6 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C150/C150M, Type I, and clean, natural sand, ASTM C144 or ASTM C404. Mix at ratio of 1 part cement to 2-1/2 to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218/C1218M.
- B. Nonmetallic, Nonshrink Grout: Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107/C1107M, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218/C1218M.
- C. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C881/C881M, of type, grade, and class to suit requirements.

2.7 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
- B. Limit use of fly ash and ground granulated blast-furnace slag to 20 percent of portland cement by weight; limit metakaolin and silica fume to 10 percent of portland cement by weight.
- C. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.
- D. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 117 when tested according to ASTM C1218/C1218M.

- E. Normal-Weight Concrete Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi minimum.
- F. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to ASTM C642, except for boiling requirement.
- G. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.
- H. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

2.8 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
 - 1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on the Contract Drawings.
- D. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.
- E. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses and specified in-place loads.
- F. Prestress tendons for architectural precast concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 117.
- G. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- H. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.
 - 1. Place backup concrete mixture to ensure bond with face-mixture concrete.
- I. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 117.

1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants." Ensure adequate bond between face and backup concrete, if used.
- J. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.
- K. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that does not show in finished structure.
- L. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- M. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Architect's approval.

2.9 FABRICATION TOLERANCES

- A. Fabricate architectural precast concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

2.10 FINISHES

- A. Exposed faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved design reference sample and as follows:

1. Design Reference Sample: Coreslab Structures 9-9-21A, Acid Etch.
 - a. Sample image for reference.



- 2.
3. As-Cast Surface Finish: Provide surfaces to match approved sample for acceptable surface, air voids, sand streaks, and honeycomb.
4. Acid-Etched Finish: Use acid and hot-water solution, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces. Protect hardware, connections, and insulation from acid attack.

- B. Finish exposed back surfaces of architectural precast concrete units with smooth, steel-trowel finish.

2.11 CLAY FACING MATERIALS

- A. Thin Brick: ASTM C 1088, Type TBX or TBS, tested in accordance with ASTM C67, not less than ½ inch or more than 1 inch, and as follows:

1. Products: Subject to compliance with requirements, provide the following:

a. Manufacturer: Endicott Thin Brick, LLC.

1) Blended to match the following colors:

- a) 40% Golden Buff
- b) 30% Copper Canyon
- c) 20% Desert Ironspot Light
- d) 10% Desert Ironspot Dark

2) Velour texture

3) Modular thin brick

4) Thin Brick Sample Panel Image, for visual reference only.



- 2. Dimensional Tolerances: Plus 0 inches or minus 1/16" for any dimension 8 inches or less and plus 0 inches or minus 3/32 inch for any dimension more than 8 inches.
- 3. Out-of-Square Tolerance: Plus or minus 1/16 inch.
- 4. Warpage Tolerance: Not more than 1/16 inch either concave or convex from consistent plane.
- 5. Variation of Shape from Specified Angle: Plus or minus one degree.
- 6. Modulus of Rupture: Not less than 250 psi when tested in accordance with ASTM C67/C67M.
- 7. Tensile Bond Strength: Not less than 150 psi when tested before and after freeze-thaw test in accordance with ASTM E488/E488M as modified: Adhere a steel plate with welded rod on a single thin-brick face with epoxy for each test.
- 8. 24-Hour Cold Water Absorption: Not more than 6 percent when tested in accordance with ASTM C67/C67M
- 9. Freeze-Thaw Resistance: No detectable disintegration or separation after 300 cycles when tested in accordance with ASTM C666/C666M, Method A or B.
- 10. Chemical Resistance: Tested in accordance with ASTM C650 and rated "not affected."
- 11. Efflorescence: Tested in accordance with C67/C67M and rated "not effloresced."
- 12. Back Surface Texture: Scored, combed, wire roughened, ribbed, keybacked, or dovetailed.
- 13. Closure Face Size: 3-5/8 inches high by 7-5/8 inches long.
- 14. Special Shapes: Include corners, edge corners, and end edge corners.

2.12 SOURCE QUALITY CONTROL

- A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6, ASTM C1610/C1610M, ASTM C1611/C1611M, ASTM C1621/C1621M, and ASTM C1712.
- B. Owner will employ an independent testing agency to evaluate architectural precast concrete fabricator's quality-control and testing methods.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.
- B. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.
 - 1. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 - 2. Unless otherwise indicated, maintain uniform joint widths of 3/4 inch.
- C. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
- D. Welding: Comply with applicable requirements in AWS D1.1/D1.1M and AWS D1.4/D1.4M for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
- E. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
- F. Grouting or Dry-Packing Connections and Joints: Grout connections where required or indicated. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces. Promptly remove grout material from exposed surfaces before it affects finishes or hardens. Keep grouted joints damp for not less than 24 hours after initial set.

3.2 ERECTION TOLERANCES

- A. Erect architectural precast concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

3.3 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections and prepare reports:
 - 1. Erection of loadbearing precast concrete members.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.
- C. Visually inspect field welds and test according to ASTM E165 or to ASTM E709 and ASTM E1444. High-strength bolted connections are subject to inspections.
- D. Testing agency will report test results promptly and in writing to Contractor and Architect.
- E. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.

- F. Additional testing and inspecting, at Contractor's expense, shall be performed to determine compliance of replaced or additional work with specified requirements.

3.4 REPAIRS

- A. Repair architectural precast concrete units if permitted by Architect. Architect reserves the right to reject repaired units that do not comply with requirements.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A780/A780M.
- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- E. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.5 CLEANING

- A. Clean surfaces of precast concrete units exposed to view.
- B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
 - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Protect other work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 034500

SECTION 21 01 00 – GENERAL REQUIREMENTS FOR FIRE SUPPRESSION

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. Division 21, 22 and 23 Conditions apply to this Section.
- C. Include and edit paragraph below if fire suppression system will be commissioned. This is not common.
- D. The Owner has contracted directly with the Commissioning Authority (CxA) for this project. All Contractors shall co-operate with the CxA to complete all required commissioning. Specification Section 23 08 00 defines the Contractor's responsibilities with respect to the process. The Contractor shall review this section and shall include in their bids the work associated with the commissioning effort described.

1.2 SUMMARY

- A. This Section includes general fire suppression requirements and shall apply to all phases of the work specified, indicated on the drawings or required to provide for complete installation of fire suppression systems.
- B. References below assume project includes the "combined" versions of the referenced sections. Modify section titles as necessary. Combined with Division 23 is the most common.
- C. Refer to Section 23 01 00 for "General Requirements for Mechanical Systems."
- D. Refer to Section 23 05 00 for "Basic Mechanical Materials and Methods."
- E. Refer to Section 23 05 05 for "Basic Mechanical Piping Materials and Methods."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 21 01 00

SECTION 21 10 00 - WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes fire suppression system renovations and additions in buildings with existing fire suppression system.
- B. This Section includes the following fire-suppression piping inside the building:
 - 1. Wet-pipe sprinkler systems.

1.3 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.4 PERFORMANCE REQUIREMENTS

- A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.
- B. Fire-suppression system design shall be approved by authorities having jurisdiction.
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 2. Sprinkler Occupancy Hazard Classifications: Per NFPA 13
 - 3. Minimum Density for Automatic-Sprinkler Piping Design: Per NFPA 13
 - 4. Maximum Protection Area per Sprinkler: Per UL listing
 - 5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13

1.5 SUBMITTALS

- A. Qualification Data: fire sprinkler designer with NICET-III certification or registered professional fire protection engineer.
- B. Product Data: For the following:
 - 1. Piping materials, including sprinkler specialty fittings.
 - 2. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.
 - 3. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.

- C. Preliminary Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, submitted to architect/Engineer for preliminary review prior to submitting to authorities having jurisdiction.
- D. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable.
- E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- F. Operation and Maintenance Data: For standpipe and sprinkler specialties to include in emergency, operation, and maintenance manuals.
- G. See "Submittal Schedule" at the end of Section 23 01 00 – "General Requirements for Mechanical Systems."

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified fire sprinkler designer with NICET-III certification or registered professional fire protection engineer.
- B. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13, "Installation of Sprinkler Systems."

1.7 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

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, but are not limited to, manufacturers specified.

2.2 STEEL PIPE AND FITTINGS

- A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed threaded ends.
 - 1. Cast-Iron Threaded Flanges: ASME B16.1.

2. Malleable-Iron Threaded Fittings: ASME B16.3.
 3. Gray-Iron Threaded Fittings: ASME B16.4.
 4. Steel Threaded Couplings: ASTM A 865.
- B. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795.
1. Locking-Lug Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn to secure pipe in fitting.
- C. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795.
1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
 2. Steel Flanges and Flanged Fittings: ASME B16.5.
- D. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed, square-cut- or roll-grooved ends.
1. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
 2. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, rubber gasket listed for use with housing, and steel bolts and nuts.
- E. Threaded-End, Schedule 30 Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and equal to or greater than Schedule 30; or ASTM A 795 and ASME B36.10M, Schedule 30 wrought-steel pipe; with factory- or field-threaded ends.
1. Cast-Iron Threaded Flanges: ASME B16.1.
 2. Malleable-Iron Threaded Fittings: ASME B16.3.
 3. Gray-Iron Threaded Fittings: ASME B16.4.
 4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
 5. Steel Threaded Couplings: ASTM A 865.
- F. Plain-End, Schedule 30 Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and equal to or greater than Schedule 30; or ASTM A 795 and ASME B36.10M, Schedule 30 wrought-steel pipe.
1. Locking-Lug Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn to secure pipe in fitting.
- G. Plain-End, Schedule 30 Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and equal to or greater than Schedule 30; or ASTM A 795 and ASME B36.10M, Schedule 30 wrought-steel pipe.
1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
 2. Steel Flanges and Flanged Fittings: ASME B16.5.
- H. Grooved-End, Schedule 30 Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and equal to or greater than Schedule 30; or ASTM A 795 and ASME B36.10M, Schedule 30 wrought-steel pipe; with factory- or field-formed, roll-grooved ends.
1. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
 2. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, rubber gasket listed for use with housing, and steel bolts and nuts.

- I. Plain-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10.
 - 1. Locking-Lug Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn to secure pipe in fitting.
- J. Plain-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10.
 - 1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
 - 2. Steel Flanges and Flanged Fittings: ASME B16.5.
- K. Grooved-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10; with factory- or field-formed, roll-grooved ends.
 - 1. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
 - 2. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, rubber gasket listed for use with housing, and steel bolts and nuts.

2.3 DIELECTRIC FITTINGS

- A. Assembly shall be copper alloy, ferrous, and insulating materials with ends matching piping system.
- B. Dielectric Unions: Factory-fabricated assembly, designed for 250-psig minimum working pressure at 180 deg F. Include insulating material that isolates dissimilar materials and ends with inside threads according to ASME B1.20.1.
- C. Dielectric Flanges: Factory-fabricated companion-flange assembly, for 175-psig minimum working-pressure rating as required for piping system.
- D. Dielectric Flange Insulation Kits: Components for field assembly shall include CR or phenolic gasket, PE or phenolic bolt sleeves, phenolic washers, and steel backing washers.
- E. Dielectric Couplings: Galvanized steel with inert and noncorrosive thermoplastic lining and threaded ends and 300-psig working-pressure rating at 225 deg F.
- F. Dielectric Nipples: Electroplated steel with inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved ends and 300-psig working-pressure rating at 225 deg F.

2.4 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping.
- B. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.
- C. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.

2.5 LISTED FIRE-PROTECTION VALVES

- A. Valves shall be UL listed with 175-psig minimum pressure rating.

- B. Ball Valves: Comply with UL 1091, except with ball instead of disc.
 - 1. NPS 1-1/2 and Smaller: Bronze body with threaded ends.
 - 2. NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
 - 3. NPS 3: Ductile-iron body with grooved ends.
- C. Butterfly Valves: UL 1091.
 - 1. NPS 2 and Smaller: Bronze body with threaded ends.
 - 2. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.
- D. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.

2.6 SPECIALTY VALVES

- A. Sprinkler System Control Valves: UL listed or FMG approved, cast- or ductile-iron body with flanged or grooved ends, and 175-psig minimum pressure rating.
- B. Pressure-Regulating Valves: UL 1468, brass or bronze, 400-psig minimum rating. Include female NPS inlet and outlet, adjustable setting feature, and straight or 90-degree-angle pattern design as indicated.
- C. Automatic Drain Valves: UL 1726, NPS 3/4, ball-check device with threaded ends.

2.7 SPRINKLERS

- A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating.
- B. Automatic Sprinklers: With heat-responsive element complying with the following:
 - 1. UL 199, for nonresidential applications.
- C. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.
- D. Sprinkler types, features, and options as follows:
 - 1. Pendent sprinklers.
 - 2. Recessed sprinklers, including escutcheon.
 - 3. Sidewall sprinklers.
 - 4. Upright sprinklers.
- E. Sprinkler Finishes: Chrome plated, bronze, and painted.
- F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
 - 1. Ceiling Mounting: Color selected by architect from supplier's standard colors.
 - 2. Sidewall Mounting: Color selected by architect from supplier's standard colors.
- G. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

2.8 PRESSURE GAGES

- A. Description: UL 393, 3-1/2- to 4-1/2-inch- diameter, dial pressure gage with range of 0 to 250 psig minimum.
 - 1. Water System Piping: Include caption "WATER" on dial face.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.
- B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PIPING APPLICATIONS, GENERAL

- A. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

3.3 SPRINKLER SYSTEM PIPING APPLICATIONS

- A. Standard-Pressure, Wet-Pipe Sprinkler System, 175-psig Maximum Working Pressure:
 - 1. Sprinkler Mains:
 - a. Steel piping as allowed by NFPA13 and Authority Having Jurisdiction.
 - 2. Branch Piping:
 - a. Steel piping as allowed by NFPA13 and Authority Having Jurisdiction with wall thickness of schedule 10 or greater.

3.4 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Listed Fire-Protection Valves: UL listed and FMG approved for applications where required by NFPA 13.
 - a. Shutoff Duty: Use ball or butterfly valves. Gate valves shall be used only where required by code.
 - 2. Unlisted General-Duty Valves: For applications where UL-listed valves are not required by NFPA 13.
 - a. Shutoff Duty: Use ball or butterfly valves.
 - b. Throttling Duty: Use ball valves.

3.5 JOINT CONSTRUCTION

- A. Refer to Division 21 Section "Basic Piping Materials and Methods Fire Suppression" for basic piping joint construction.
- B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 (DN 200) with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.
- C. Twist-Locked Joints: Insert plain-end piping into locking-lug fitting and rotate retainer lug one-quarter turn.
- D. Pressure-Sealed Joints: Use UL-listed tool and procedure. Include use of specific equipment, pressure-sealing tool, and accessories.
- E. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.
 - 1. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
 - 2. General Requirements:
 - a. All grooved joint couplings, fittings, valves, and specialties shall be the products of a same manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
 - b. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.
 - c. Couplings shall be fully installed at visual pad-to-pad offset contact. Couplings that require gapping of bolt pads or specific torque ratings for proper installation are not permitted.
 - d. Install in accordance with the manufacturer's latest published installation instructions. Pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to (and including) groove. Gasket shall be manufactured by the coupling manufacturer and verified as suitable for the intended service. A factory trained representative (direct employee) of the coupling manufacturer shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and product installation. The representative shall periodically visit the job site and review installation to ensure best practices in grooved joint installation are being followed. Contractor shall remove and replace any improperly installed products.
- F. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials.
 - 1. NPS 2 and Smaller: Use dielectric unions, couplings, or nipples.
 - 2. NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.6 PIPING INSTALLATION

- A. Refer to Division 21 Section "Basic Piping Materials and Methods for Fire Suppression" for basic piping installation.
- B. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- E. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.

- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage.
- H. Hangers and Supports: Comply with NFPA 13 for hanger materials.
- I. Fill wet-pipe sprinkler system piping with water.

3.7 VALVE INSTALLATION

- A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water supply sources.
- D. Specialty Valves:
 - 1. Alarm Check Valves: Install in vertical position for proper direction of flow, including bypass check valve and retarding chamber drain-line connection.

3.8 SPRINKLER APPLICATIONS

- A. Drawings indicate sprinkler types to be used. Where specific types are not indicated, use the following sprinkler types:
 - 1. Rooms without Ceilings: Upright sprinklers.
 - 2. Wall Mounting: Sidewall sprinklers.
 - 3. Sprinkler Finishes:
 - a. Upright, Pendent, and Sidewall Sprinklers: Color selected by architect from standard supplier color options in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view.

3.9 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels and tiles.
- B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

3.10 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

- C. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.
- D. Electrical Connections: Power wiring is specified in Division 26.
- E. Coordinate with Electrical contractor to connect alarm devices to fire alarm.

3.11 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

3.12 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Energize circuits to electrical equipment and devices.
 - 4. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 5. Verify that equipment hose threads are same as local fire department equipment.
- B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.13 CLEANING AND PROTECTION

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.
- C. Protect sprinklers from damage until Substantial Completion.

3.14 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 21 10 00

SECTION 22 01 00 – GENERAL REQUIREMENTS FOR PLUMBING

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.

PART 2 - Edit divisions not part of the project.

- A. Division 21, 22 and 23 Conditions apply to this Section.
- B. The Owner has contracted directly with the Commissioning Authority (CxA) for this project. All Contractors shall co-operate with the CxA to complete all required commissioning. Specification Section 23 08 00 defines the Contractor's responsibilities with respect to the process. The Contractor shall review this section and shall include in their bids the work associated with the commissioning effort described.

2.2 SUMMARY

- A. This Section includes general mechanical requirements and shall apply to all phases of the work specified, indicated on the drawings or required to provide for complete installation of plumbing systems.
- B. Refer to Section 23 01 00 for "General Requirements for Mechanical Systems."
- C. Refer to Section 23 05 00 for "Basic Mechanical Materials and Methods."
- D. Refer to Section 23 05 05 for "Basic Mechanical Piping Materials and Methods."

PART 3 - PRODUCTS (Not Applicable)

PART 4 - EXECUTION (Not Applicable)

END OF SECTION 22 01 00

SECTION 22 05 23 – VALVES FOR PLUMBING

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 general duty valves common to several mechanical piping systems. Special purpose valves are specified in Division 22 piping system Sections.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.
- C. Maintenance data for valves to include in the operation and maintenance manual specified in Division 01. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.
- D. See "Submittal Schedule" at the end of Section 23 01 00 "General Requirements for Mechanical Systems."

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.
- B. All valves used in potable water service shall be certified lead free per NSF-61G and NSF 372.
- C. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ball Valves:
 - a. Conbraco Industries, Inc.; Apollo Division.
 - b. Hammond Valve Corporation.
 - c. Milwaukee Valve Company, Inc.

- d. NIBCO Inc.
- e. Stockham Valves & Fittings, Inc.
- f. Tyler Pipe.
- g. Victaulic Company of America.

2. Check Valves:

- a. Cla-Val Co.
- b. Conbraco Industries, Inc.; Apollo Division.
- c. Hammond Valve Corporation.
- d. Keystone Valve USA, Inc.
- e. Kitz Corp. of America.
- f. Metraflex Company.
- g. Milwaukee Valve Company, Inc.
- h. NIBCO Inc.
- i. Red-White Valve Corp.
- j. Stockham Valves & Fittings, Inc.
- k. Tyler Pipe.
- l. Val-Matic Valve & Mfg. Corp.
- m. Victaulic Company of America.

2.2 BASIC, COMMON FEATURES

- A. Pressure and Temperature Ratings: As indicated in the "Application Schedule" of Part 3 of this Section and as required to suit system pressures and temperatures.
- B. Sizes: Same size as upstream pipe, unless otherwise indicated.
- C. Operators: Use specified operators and handwheels, except provide the following special operator features:
 - 1. Handwheels: For valves other than quarter turn.
 - 2. Lever Handles: For quarter-turn valves 6 inches and smaller.
 - 3. Memory Stops: For balancing applications.
- D. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
- E. Threads: ASME B1.20.1.
- F. Flanges: ASME B16.1 for cast iron, ASME B16.5 for steel, and ASME B16.24 for bronze valves.
- G. Solder Joint: ASME B16.18.

2.3 BRONZE BALL VALVES

- A. Ball Valves, 4 Inches and Smaller: MSS SP-110, Class 150, 600-psi CWP, ASTM B 584 or ASTM B283 bronze body and bonnet, 2-piece construction; chrome-plated brass ball, standard port for 1/2-inch valves and smaller and conventional port for 3/4-inch valves and larger; blowout proof; bronze or brass stem; teflon seats and seals; threaded or soldered end connections, lever handle operator. Valves shall be certified lead free.

2.4 CHECK VALVES

- A. Swing Check Valves, 2-1/2 Inches and Smaller: MSS SP-80; Class 125, 200-psi CWP, or Class 150, 300-psi CWP; horizontal swing, Y-pattern, ASTM B 62 cast-bronze body and cap, rotating bronze disc with rubber seat or composition seat, threaded or soldered end connections. Valves shall be certified lead free.
- B. Wafer Check Valves: Class 125, 200-psi CWP, ASTM A 126 cast-iron body, bronze disc/plates, stainless-steel pins and springs, Buna N seals, installed between flanges. Valves shall be certified lead free.
- C. Lift Check Valves: Class 125, ASTM B 62 bronze body and cap (main components), horizontal or vertical pattern, lift-type, bronze disc or Buna N rubber disc with stainless-steel holder threaded or soldered end connections. Valves shall be certified lead free.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

- A. Install valves as indicated, according to manufacturer's written instructions.
- B. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
- C. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
- D. Locate valves for easy access and provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the center of the pipe.
- F. Install valves in a position to allow full stem movement.
- G. Installation of Check Valves: Install for proper direction of flow as follows:
 - 1. Swing Check Valves: Horizontal position with hinge pin level.
 - 2. Wafer Check Valves: Horizontal or vertical position, between flanges.

3. Lift Check Valve: With stem upright and plumb.

3.3 IDENTIFICATION

- A. Install valve tags. Comply with requirements in Section 23 05 53 "Identification for Mechanical Piping and Equipment" for valve tags and schedules.

3.4 VALVE END SELECTION

- A. Select valves with the following ends or types of pipe/tube connections:
 1. Copper Tube Size, 2-1/2 Inches and Smaller: Solder ends.
 2. Steel Pipe Sizes, 2-1/2 Inches and Smaller: Threaded or grooved end.

3.5 APPLICATION SCHEDULE

- A. General Application:
 1. Use ball valves for shutoff duty.
 2. Use ball valves for throttling duty.
 3. Refer to piping system Specification Sections for specific valve applications and arrangements.
- B. Domestic Water Systems: Use the following valve types:
 1. Ball Valves: Class 150, 600-psi CWP, with stem extension.
 2. Bronze Swing Check: Class 125, with rubber seat.
 3. Check Valves: Class 125, swing or wafer type as indicated.

3.6 ADJUSTING

- A. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

END OF SECTION 22 05 23

SECTION 22 07 20 - PIPE INSULATION FOR PLUMBING

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 preformed, rigid and flexible pipe insulation; insulating cements; accessories and attachments; and sealing compounds.

1.3 SUBMITTALS

- A. Product Data: Include product data description, list of materials, thickness, density and k-values for each product type, locations, manufacturer's installation instructions, flames spread and smoke developed ratings.
- B. See "Submittal Schedule" at the end of Section 23 01 00 "General Requirements for Mechanical Systems."

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Mineral-Fiber Insulation:
 - a. CertainTeed Manson.
 - b. Knauf FiberGlass GmbH.
 - c. Owens-Corning Fiberglas Corp.
 - d. Schuller International, Inc.
 - 2. Flexible Elastomeric Thermal Insulation:
 - a. Armstrong World Industries, Inc.
 - b. Rubatex Corp.

2.2 INSULATION MATERIALS

- A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
 - a. Nominal density is 2.5 lb/cu. Ft. or more.
 - b. Thermal conductivity (k-value) at 100 deg F is 0.28 Btu x in./h x sq. ft. x deg F or less
 2. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
 - a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
 - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
 3. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
 4. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
 5. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
- B. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
- a. Thermal conductivity (k-value) at 90 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less.
 2. Adhesive: As recommended by insulation material manufacturer.
 3. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.
- C. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- D. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil- thick, high-impact, ultraviolet-resistant PVC.
1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
 2. Adhesive: As recommended by insulation material manufacturer.
- E. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes. Comply with ASTM B 209, 3003 alloy, H-14 temper.
1. Finish and Thickness: Smooth finish, 0.010 inch thick.
 2. Finish and Thickness: Corrugated finish, 0.010 inch thick.
 3. Finish and Thickness: Stucco-embossed finish, 0.016 inch thick.
 4. Finish and Thickness: Painted finish, 0.016 inch thick.
 5. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 6. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.

2.3 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, pre-sized a minimum of 8 oz./sq. yd, 4 inch tape width.

- B. Bands: 3/4 inch wide, materials compatible with jacket:
- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.

2.4 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.2 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- C. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- D. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- E. Apply insulation with the least number of joints practical.
- F. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- G. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
- H. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- I. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- J. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.

2. Circumferential Joints: Cover with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.
 4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
 5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
- K. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- L. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- M. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- N. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Division 07 for firestopping and fire-resistive joint sealers.
- O. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07.

3.3 MINERAL-FIBER INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes by securing each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
- B. Apply preformed pipe insulation to outer diameter of pipe flange.
- C. Apply insulation to fittings and elbows as follows:
1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
 3. Cover fittings with standard PVC fitting covers.
- D. Apply insulation to valves and specialties as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
4. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.4 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
1. Follow manufacturer's written instructions for applying insulation.
 2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- B. Apply pipe insulation to outer diameter of pipe flanges.
- C. Apply insulation to fittings and elbows as follows:
1. Apply mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- D. Apply insulation to valves and specialties as follows:
1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
 2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

3.5 INSTALLATION OF FIELD-APPLIED JACKETS

- A. Where aluminum 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.

3.6 INSULATION APPLICATION SCHEDULE

- A. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
1. Flexible connectors.
 2. Vibration-control devices.
 3. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.
- B. See drawings for "PIPING INSULATION SCHEDULE".

END OF SECTION 22 07 20

SECTION 22 11 16 - WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes water distribution piping from locations indicated to fixtures and equipment inside building.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with the 125 psig minimum working-pressure ratings, unless otherwise indicated:

1.4 QUALITY ASSURANCE

- A. Provide listing/approval stamp, label, or other marking on piping made to specified standards.
- B. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
- C. NSF Compliance:
 - 1. Comply with NSF 61 Annex G for materials for water-service piping and specialties for domestic water.
- D. Installer Qualifications: Installers of pressure-sealed joints are to be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

1.5 SUBMITTALS

- A. Product Data: Tube and fittings.
- B. System purging and disinfecting activities report.
- C. Field quality-control reports.
- D. See "Submittal Schedule" at the end of Section 23 01 00 "General Requirements for Mechanical Systems."

1.6 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:

1. Notify Construction Manager and Owner no fewer than two weeks in advance of proposed interruption of water service.
2. Do not proceed with interruption of water service without Construction Manager's and Owner's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Domestic water piping, tubing, fittings, joints, and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PIPES AND TUBES

- A. General: Applications of the following pipe and tube materials are indicated in Part 3 "Piping Applications" Article.
- B. Soft Copper Tube: ASTM B 88, Types K, water tube, annealed temper.
- C. Hard Copper Tube: ASTM B 88, Types L, water tube, drawn temper.

2.3 PIPE AND TUBE FITTINGS

- A. General: Applications of the following pipe and tube fitting materials are indicated in Part 3 "Piping Applications" Article.
- B. Copper, Solder-Joint Pressure Fittings: ASME B16.18 cast-copper alloy or ASME B16.22 wrought copper.
- C. Copper, Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.
- D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
- E. Copper Unions: ASME B16.18, cast-copper-alloy, hexagonal-stock body with ball-and-socket joint, metal-to-metal seating surfaces, and solder-joint, threaded, or solder-joint and threaded ends. Include threads conforming to ASME B1.20.1 on threaded ends.
- F. Pressure-Seal-Joint Fittings, Copper or Bronze - Domestic Water:
 1. Source Limitations: Obtain pressure-seal-joint fittings, copper or bronze, from single manufacturer.
 2. Housing: Copper.
 3. O-Rings and Pipe Stops: EPDM.
 4. Tools: Manufacturer's special tools.
 5. Minimum 200 psig working-pressure rating at 250 deg F.

2.4 JOINING MATERIALS

- A. General: Applications of the following piping joining materials are indicated in Part 3 "Piping Applications" Article.

- B. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for commonly used joining materials.
- C. Solder: ASTM B 32, Alloy Sn95, Sn94, or E; lead free.
- D. Brazing Filler Metal: AWS A5.8, BCuP, copper phosphorus or BAg, silver classification.
- E. Transition Couplings: Coupling or other manufactured fitting same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.
- F. Mechanical Couplings for Grooved-End Copper Tubing: Copper-tube dimensions and design similar to AWWA C606, ferrous housing sections, EPDM-rubber gaskets suitable for domestic hot and cold water (gasket to serve as dielectric fitting), bolts and nuts. Minimum pressure rating = 300 psig.

2.5 VALVES

- A. Refer to Division 22 Section "Valves for Plumbing" for general-duty valves.
- B. Refer to Division 22 Section "Plumbing Specialties" for special-duty valves.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
- B. Fitting Option: Mechanically formed tee-branch outlets and brazed joints may be used on aboveground copper tubing.
- C. Water Distribution Piping:
 - 1. Aboveground (2-1/2 Inch NPS and Smaller): Hard copper tube, Type L; copper, solder-joint fittings; and soldered joints or copper pressure-seal-joint fittings; and pressure-sealed joints.
 - 2. Underground: Soft copper tube, Type K; wrought-copper, solder-joint pressure fittings; and soldered joints.

3.2 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use ball valves.
 - 2. Throttling Duty: Use ball valves.

3.3 PIPING INSTALLATION, GENERAL

- A. Refer to Division 23 Section "Basic Mechanical Piping Materials and Methods" for basic piping installation.
- B. Install piping level without pitch or with 0.25 percent slope downward toward drain when drains are indicated.

3.4 JOINT CONSTRUCTION

- A. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.

3.5 VALVE INSTALLATION

- A. Shutoff Valves: Install shutoff valve on each water supply to equipment, on each supply to plumbing fixtures without supply stops, and where indicated. Use ball valves for piping 2-inch NPS and smaller.
- B. Drain Valves: Install hose-end drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.

3.6 FIELD QUALITY CONTROL

- A. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- B. Test water distribution piping as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave interior piping uncovered and unconcealed new, altered, extended, or replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
 - 3. Cap and subject piping to static water pressure as required by the local Plumbing Code. If the local Plumbing Code does not stipulate testing requirements, cap and subject piping to static water pressure of 100 psig, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for 15 minutes. Leaks and loss in test pressure constitute defects that must be repaired.
 - 4. If testing is to be performed at temperatures below freezing, an air test may be performed in lieu of water testing if allowed by local plumbing code and approved by engineer.
 - 5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.

3.7 CLEANING

- A. Clean and disinfect service entrance piping and water distribution piping as follows:
 - 1. Purge new piping and parts of existing water piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed, procedure described in either AWWA C651 or AWWA C652 or as described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.

- 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for 3 hours.
- c. Flush system with clean, potable water until chlorine is no longer in water coming from system after the standing time.
- B. Prepare and submit reports for purging and disinfecting activities.
- C. Clean interior of piping system. Remove dirt and debris as work progresses.

3.8 START-UP

- A. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
- B. Perform the following steps before putting into operation:
 1. Close drain valves, hydrants, and hose bibbs.
 2. Open shutoff valves to fully open position.
 3. Open throttling valves to proper setting.
 4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
 5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
- C. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.
- D. Set water-pressure regulators at 80 psig maximum outlet pressure, unless otherwise indicated.

END OF SECTION 22 11 16

SECTION 22 13 16 - DRAINAGE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes sanitary drainage and vent piping inside building and to locations indicated.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Soil, Waste and Vent Piping: 10-foot head of water.

1.4 SUBMITTALS

- A. Test Results and Reports: Specified in "Field Quality Control" Article.
- B. See "Submittal Schedule" located at the end of Section 23 01 00 "General Requirements for Mechanical Systems."

1.5 QUALITY ASSURANCE

- A. Provide listing/approval stamp, label, or other marking on piping made to specified standards.
- B. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

1.6 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:
 - 1. Notify Construction Manager and Owner no fewer than two weeks in advance of proposed interruption of sanitary waste service.
 - 2. Do not proceed with interruption of sanitary waste service without Construction Manager's and Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPES AND TUBES

- A. General: Applications of the following pipe and tube materials are indicated in Part 3 "Piping Applications" Article.
- B. Hub-and-Spigot, Cast-Iron Soil Pipe: ASTM A 74, Service and Extra Heavy classes. Include ASTM C 564 rubber gasket, with dimensions required for pipe class, for each hub.
- C. Hubless, Cast-Iron Soil Pipe: ASTM A 888 or CISPI 301.
- D. Hard Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.
- E. Hard Copper Tube: ASTM B 306, drainage tube, drawn temper.

2.2 PIPE AND TUBE FITTINGS

- A. General: Applications of the following pipe and tube fitting materials are indicated in Part 3 "Piping Applications" Article.
- B. Threaded-Fitting, End Connections: ASME B1.20.1.
- C. Hub-and-Spigot, Cast-Iron, Soil-Pipe Fittings: ASTM A 74, Service and Extra Heavy classes, hub and spigot. Include ASTM C 564 rubber gasket, with dimensions required for pipe class, for each hub.
- D. Hubless, Cast-Iron, Soil-Pipe Fittings: CISPI 301.
- E. Copper, Solder-Joint Drainage Fittings: ASME B16.23 cast copper or ASME B16.29 wrought copper.

2.3 JOINING MATERIALS

- A. Refer to Division 23 Section "Basic Mechanical Piping Materials and Methods" for commonly used joining materials.
- B. Solder: ASTM B 32, Alloy Sn95, Sn94, or E; lead free.
- C. Hubless, Cast-Iron, Soil-Piping Couplings: CISPI 310/NSF assembly of metal housing, corrosion-resistant fasteners, and ASTM C 564 rubber sleeve or gasket with integral, center pipe stop. Neoprene Couplings with stainless steel clamps.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
- B. Aboveground, Sanitary Waste and Vent Piping: Use the following:
 - 1. 1-1/2 to 10-Inch NPS: Hubless, cast-iron soil pipe; hubless, cast-iron, soil-pipe fittings; and hubless, cast-iron, soil-piping couplings.
 - 2. 1-1/4 to 4-Inch NPS: Hard copper drainage tube; copper, solder-joint drainage fittings; and soldered joints.
- C. Underground, Sanitary Waste and Vent Piping: Use the following:

1. 2- to 12-Inch NPS: Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.
2. 2- to 10-Inch NPS: Hubless, cast-iron soil pipe; hubless, cast-iron, soil-pipe fittings; and hubless, cast-iron, soil-piping couplings.

3.2 PIPING INSTALLATION

- A. Refer to Division 23 Section "Basic Mechanical Piping Materials and Methods" for basic piping installation.
- B. Extend building storm drain piping and connect to storm sewer piping in sizes and locations indicated for service entrances into building. Install double grade cleanout and extension to grade at connections of building storm drains and building storm sewers.
- C. Install wall penetration system at each service entrance pipe penetration through foundation wall. Make installation watertight. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for wall penetration systems.
- D. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- E. Make changes in direction for drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not make change in direction of flow greater than 90 degrees. Use proper size of standard increasers and reducers if different sizes of piping are connected. Reducing size of drainage piping in direction of flow is prohibited.
- F. Lay buried building drain piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- G. Install drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 1. Sanitary Drain: Unless otherwise indicated, 1/4" per foot downward in direction of flow for piping 3-inch NPS and smaller; 1/8" per foot downward in direction of flow for piping 4-inch NPS and larger.
 2. Vent Piping: 1/8" per foot downward toward vertical fixture vent or toward vent stack.
- H. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 1. Compression Joints: Make with rubber gasket matching class of pipe and fittings.
 2. Hubless Joints: Make with rubber gasket and sleeve or clamp.

3.3 FIELD QUALITY CONTROL

- A. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- B. Test drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedure, as follows:
 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
3. Roughing-In Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10 feet of head. Water level must not drop from 15 minutes before inspection starts through completion of inspection. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects using new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.4 CLEANING AND PROTECTING

- A. Clean interior of piping system. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 22 13 16

SECTION 22 13 19 - PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes plumbing specialties for the following:
 - 1. Water distribution systems.
 - 2. Soil, waste, and vent systems.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Water Distribution Piping: 125 psig.
 - 2. Soil, Waste, and Vent Piping: 10-foot head of water.

1.4 SUBMITTALS

- A. Product Data: For each plumbing specialty indicated. Include rated capacities of selected equipment and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for the following plumbing specialty products:
 - 1. Backflow preventers.
 - 2. Water regulators.
 - 3. Drain valves.
 - 4. Hose bibbs and hydrants.
 - 5. Cleanouts.
 - 6. Floor drains.
- B. Maintenance Data: For specialties to include in the maintenance manuals. Include the following:
 - 1. Backflow preventers.
 - 2. Water regulators.
 - 3. Hose stations.
 - 4. Sanitary hydrants.
- C. See "Submittal Schedule" located at the end of Section 23 01 00 "General Requirements for Mechanical Systems."

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, dimensional requirements, and characteristics of plumbing specialties and are based on the specific types and models indicated. Other manufacturers' products with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."
- B. Provide listing/approval stamp, label, or other marking on plumbing specialties made to specified standards.
- C. Listing and Labeling: Provide electrically operated plumbing specialties specified in this Section that are listed and labeled as defined in National Electrical Code, Article 100.
- D. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Backflow Preventers:

- a. Ames Co., Inc.
- b. B & K Industries, Inc.
- c. Cla-Val Co.
- d. CMB Industries; Febco Div.
- e. Conbraco Industries, Inc.
- f. FLOMATIC Corp.
- g. Grinnell Corp.; Mueller Co. Marketing Group for Hersey Products Div.
- h. IMI Cash Valve.
- i. Sparco, Inc.
- j. Watts Industries, Inc.; Water Products Div.
- k. Zurn Industries, Inc.; Wilkins Div.

- 2. Water Pressure Regulators:

- a. Bermad, Inc.
- b. Cashco, Inc.
- c. Cla-Val Co.
- d. Conbraco Industries, Inc.
- e. FLOMATIC Corp.
- f. G A Industries, Inc.
- g. Honeywell Braukmann.
- h. IMI Cash Valve.
- i. Kaye & Mac Donald, Inc.
- j. Keckley: O.C. Keckley Co.
- k. Spence Engineering Co., Inc.
- l. Watts Industries, Inc.; Water Products Div.
- m. Zurn Industries, Inc.; Wilkins Div.

- 3. Hydrants:

- a. Enpoco, Inc.
- b. Josam Co.
- c. Murdock, Inc.
- d. Smith: Jay R. Smith Mfg. Co.

- e. Tyler Pipe; Wade Div.
- f. Watts Industries, Inc.; Ancon Drain Div.
- g. Watts Industries, Inc.; Water Products Div.
- h. Woodford Manufacturing Co.
- i. Zurn Industries, Inc.; Hydromechanics Div.

4. Floor Drains

- a. Josam Co.
- b. Sioux Chief Manufacturing Co., Inc.
- c. Smith: Jay R. Smith Mfg. Co.
- d. Tyler Pipe, Wade Div.
- e. Watts Industries, Inc.; Ancon Drain Div.
- f. Zurn Industries, Inc.; Hydromechanics Div.
- g. MIFAB, Inc.

2.2 [BACKFLOW PREVENTERS

- A. General: ASSE standard, backflow preventers, of size indicated for maximum flow rate and maximum pressure loss indicated.
 - 1. 2-Inch NPS and Smaller: Bronze body with threaded ends.
 - 2. 2-1/2-Inch NPS and Larger: Bronze, cast-iron, steel, or stainless-steel body with flanged ends.
 - a. Interior Lining: AWWA C550 or FDA-approved, epoxy coating for backflow preventers having cast-iron or steel body.
 - 3. Interior Components: Corrosion-resistant materials.
 - 4. Exterior Finish: Polished chrome-plate if used in chrome-plated piping system.
 - 5. Strainer on inlet.
- B. Pipe-Applied, Atmospheric-Type Vacuum Breakers: ASSE 1001, with floating disc and atmospheric vent.
- C. Hose-Connection Vacuum Breakers: ASSE 1011, nickel plated, with nonremovable and manual drain features, and ASME B1.20.7 garden-hose threads on outlet. Units attached to rough-bronze-finish hose connections may be rough bronze.
- D. Intermediate Atmospheric-Vent Backflow Preventers: ASSE 1012, suitable for continuous pressure application. Include inlet screen and 2 independent check valves with intermediate atmospheric vent.
- E. Reduced-Pressure-Principle Backflow Preventers: ASSE 1013, suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet; test cocks; and pressure-differential relief valve with ASME A112.1.2 air-gap fitting located between 2 positive-seating check valves.
- F. Double-Check Backflow Prevention Assemblies: ASSE 1015, suitable for continuous pressure application. Include shutoff valves on inlet and outlet, and strainer on inlet; and test cocks with 2 positive-seating check valves.
- G. Hose-Connection Backflow Preventers: ASSE 1052, suitable for at least 3-gpm flow and applications with up to 10-foot head back pressure. Include 2 check valves; intermediate atmospheric vent; and nonremovable, ASME B1.20.7 garden-hose thread on outlet.]

2.3 WATER PRESSURE REGULATORS

- A. General: water regulators, rated for initial working pressure of 150 psig minimum, of size, flow rate, and inlet and outlet pressures indicated. Include integral factory-installed or separate field-installed Y-pattern strainer.
 - 1. 2-Inch NPS and Smaller: Bronze body, renewable nickel alloy seats, stainless steel internal parts, with threaded ends.
 - 2. 2-1/2-Inch NPS and Larger: Water-control valve – pilot operated, diaphragm-type, single seated, main water-pressure control valve. Provide with low flow bypass, speed controller, specialty fittings, sensor piping and valves to isolate pilot and bypass valve trim without disrupting main building service. Cast or ductile iron body, flanged ends with initial working pressure rating of 150 psig minimum. Provide with AWWA C550 or FDA-approved, interior epoxy coating.

2.4 HYDRANTS

- A. See drawings for "PLUMBING SPECIALTIES SCHEDULE"

2.5 CLEANOUTS

- A. Cleanout Plugs: Cast iron or brass, threads complying with ANSI B2.1, countersunk head. Engrave heads to identify system.
- B. Floor Cleanouts: Cast iron body and frame with cleanout plug and adjustable round nickel bronze top. Provide to match floor system:
 - 1. Exposed finish type, standard mill finish.
 - 2. Exposed flush type, standard non-slip scored or abrasive finish.
 - 3. Exposed flush type, standard mill finish and carpet marker.
 - 4. Heavy duty for traffic applications.
- C. Wall Cleanouts: Cast iron body adaptable to pipe with cast bronze, brass cleanout plug; stainless steel cover, vandal proof screws.

2.6 FLOOR DRAINS

- A. See drawings for "PLUMBING SPECIALTIES SCHEDULE"

2.7 FLASHING

- A. Floor Drains: Non-plasticized, chlorinated, polyethylene, concealed, water-proof membrane, 0.40" thick, solvent weldable. 48" square minimum.

PART 3 - EXECUTION

3.1 PLUMBING SPECIALTY INSTALLATION

- A. General: Install plumbing specialty components, connections, and devices according to manufacturer's written instructions.
- B. Install backflow preventers of type, size, and capacity indicated, at each water-supply connection to mechanical equipment and systems, and to other equipment and water systems as indicated. Comply with authorities having jurisdiction.

jurisdiction. Locate backflow preventers in same room as connected equipment. Install air-gap fitting on units with atmospheric-vent connection and pipe relief outlet drain to nearest floor drain. Do not install bypass around backflow preventer.

- C. Install pressure regulators with inlet and outlet shutoff valves and balance valve bypass. Install pressure gages on inlet and outlet.
- D. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve, and where indicated.
- E. Install cleanouts in aboveground piping and building drain piping as indicated, and where not indicated, according to the following:
 - 1. Size same as drainage piping up to 4-inch NPS. Use 4-inch NPS for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping 4-inch NPS and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
 - 5. Install wall cleanout at the beginning of an above ground horizontal waste line which serves multiple water closets.
- F. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.
- G. Install cleanout wall access covers with frame and cover flush with finished wall, for cleanouts located in concealed piping.
- H. Install individual stop valve in each water supply to plumbing specialties. Use ball valve if specific valve is not indicated. Install water-supply stop valves in accessible locations.
- I. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- J. Locate drainage piping as close as possible to bottom of floor slab supporting fixtures and drains.
- K. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and mill-work. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.
- L. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
- M. Position floor drains for easy access and maintenance.
- N. Install flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Arrange for electric-power connections to plumbing specialties and devices that require power. Electric power, wiring, and disconnect switches are specified in Division 26 Sections.
- C. Supply Runouts to Plumbing Specialties: Install hot- and cold-water-supply piping of sizes indicated, but not smaller than required by authorities having jurisdiction

- D. Drainage Runouts to Plumbing Specialties: Install drainage and vent piping, with approved trap, of sizes indicated, but not smaller than required by authorities having jurisdiction.

3.3 START-UP

- A. Before startup, perform the following checks:
 - 1. System tests are complete.
 - 2. Damaged and defective specialties and accessories have been replaced or repaired.
 - 3. Clear space is provided for servicing specialties.
- B. Before operating systems, perform the following steps:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open general-duty valves to fully open position.
 - 3. Remove and clean strainers.
 - 4. Verify that drainage and vent piping are clear of obstructions. Flush with water until clear.
- C. Startup Procedures: Follow manufacturer's written instructions. If no procedures are prescribed by manufacturer, energize circuits for electrically operated units. Start and run units through complete sequence of operations.
- D. Adjust operation and correct deficiencies discovered during commissioning.

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain, plumbing specialties.

END OF SECTION 22 13 19

SECTION 23 01 00 – GENERAL REQUIREMENTS FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Owner has contracted directly with the Commissioning Authority (CxA) for this project. All Contractors shall cooperate with the CxA to complete all required commissioning. Specification Section 23 08 00 defines the Contractor's responsibilities with respect to the process. The Contractor shall review this section and shall include in their bids the work associated with the commissioning effort described.

1.2 SUMMARY

- A. This Section includes general mechanical requirements and shall apply to all phases of the work specified, indicated on the drawings or required to provide for complete installation of all mechanical systems including fire protection systems, plumbing systems; and heating, ventilation, and air conditioning (HVAC) systems.

1.3 WARRANTIES

- A. All materials, workmanship and equipment shall be warranted against defects or against injury from proper and usual wear for a period of one year after the date of substantial completion. Any item which becomes defective within the warranty period shall be repaired or replaced, at no additional cost to the Owner.
- B. All manufacture's warranties shall run to the benefit of the Owner. No manufacturer's warranties shall be voided or impaired.
- C. Warranties shall include repair of faulty workmanship.

1.4 INTERPRETATION OF DOCUMENTS

- A. Any questions regarding the meaning of any portion of the contract documents shall be submitted to the Architect/Engineer for interpretation. Definitive interpretations or clarification will be published by addenda or supplemental information. Verbal interpretation not issued by addendum or supplemental information shall not be considered part of the contract documents.
- B. The Architect/Engineer shall be the sole judge of interpretations of discrepancies within the contract documents.
- C. If ambiguities should appear in the contract documents, the Contractor shall request clarification from the Architect/Engineer before proceeding with the work. If the Contractor fails to make such request, no excuse will thereafter be entertained for failure to carry out the work in a manner satisfactory to the Architect/Engineer. Should a conflict occur within the contract documents, the Contractor is deemed to have estimated the more expensive way of doing the work unless a written clarification from the Architect/Engineer was requested and obtained before submission of proposed methods or materials.

1.5 DEFINITIONS ABBREVIATIONS

A. The following shall apply throughout the contract documents

1.	Code	All applicable national state and local codes
2.	Furnish	Supply and deliver to site ready for installation
3.	Indicated	Noted, scheduled or specified
4.	Provide	Furnish, install and connect complete and ready for final use by owner
5.	ADA	Americans with Disabilities Act
6.	ANSI	American National Standards Institute
7.	ARI	Air-Conditioning and Refrigeration Institute
8.	ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
9.	ASME	American Society of Mechanical Engineers
10.	ASTM	American Society for Testing and Materials
11.	HI	Hydraulic Institute
12.	NEC	National Electric Code (NFPA 70)
13.	NEMA	National Electrical Manufacturers Association
14.	NFPA	National Fire Protection Association
15.	SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
16.	UL	Underwriters Laboratories Inc.

1.6 CODES AND STANDARDS

- A. All work shall be performed by competent craftsmen skilled in the trade involved and shall be done in a manner consistent with normal industry standards.
- B. All work shall conform to the currently adopted edition of the National Electric Code (NEC), 2018 International Building Code with Omaha amendments, 2012 International Mechanical Code with Omaha amendments, 2018 Omaha Plumbing Code, 2018 International Energy Conservation Code with Omaha amendments, and all other applicable state and local codes or standards.
- C. Where there is a conflict between the code and the contract documents, the code shall have precedence only then it is more stringent than the contract documents. Items that are allowed by the code but are less stringent than those specified shall not be substituted.

1.7 PERMITS

- A. Contractor shall become familiar and comply with all requirements regarding permits, fees, licenses, etc. All permits, licenses, inspections and arrangements required for the work shall be obtained by Contractor's effort and expense. All utilities shall be installed in accordance with the local rules and regulations and all charges shall be paid by the Contractor.

1.8 SUBMITTALS

- A. Division 01 section "Submittals" shall be adhered to if more stringent than this section.
- B. Submittal Procedures
1. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - a. 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.

- 1) Engineer, Architect, through Construction Manager, will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
 - b. Web-Based Project Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
- C. Shop Drawings
1. Shop drawings include fabrication and installation drawings, diagrams, schedules of other data specifically prepared for the project. Include dimensions and notations showing compliance with specified standards.
 2. Submit Product Data before Shop Drawings, and before or concurrent with Samples.
- D. Product Data
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. Product data includes printed information, such as manufacture's installation instructions, catalog cuts, standard color charts, rough-in diagrams, wiring diagrams and performance curves.
 3. Each copy shall clearly indicate conformance with specified capacities, characteristics, dimensions and details. Mark all equipment with same item number as used on drawings. Mark each copy to clearly indicate applicable products and options.
 4. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 5. 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.
 6. Submit Product Data before Shop Drawings, and before or concurrent with Samples.
- E. Samples
1. Samples are physical examples used to illustrate materials, equipment or workmanship.
 2. Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
- F. Architect/Engineer will review or take appropriate action for submittals. Review is only to determine general conformance with design shown in contract documents.
- G. Architect/Engineer review of submittals shall not relieve contractor of responsibility for deviation from requirements of the contract documents or from errors or omissions within submittals.
- H. 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/Engineer on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

- I. No portion of the work requiring submittals shall be commenced until the Architect/Engineer has reviewed the submittal.
- J. Electronic Floor Plan Drawings in AutoCAD format may be requested for use in preparation of shop drawings. Morrissey Engineering reserves the right to reject requests for electronic drawings. Submit written request to Morrissey Engineering or email request to info@morrisseyengineering.com. Indicate the project name, and floor plan sheets requested. The use of these drawings is intended solely for preparation of drawings required by this specification. Copyright law prohibits any other use. The user of the electronic files assumes full responsibility for the accuracy and scale of the drawings.
- K. See "Submittal Schedule" at the end of Section 23 01 00 "General Requirements for Mechanical Systems."

1.9 OPERATION AND MAINTENANCE MANUALS

- A. Assemble (3) complete sets of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:
 - 1. Operation Data:
 - a. Emergency instructions and procedures.
 - b. System, subsystem, and equipment descriptions, including operating standards.
 - c. Operating procedures, including startup, shutdown, seasonal, and weekend operations.
 - d. Description of controls and sequence of operations.
 - e. Piping and wiring diagrams.
 - 2. Maintenance Data:
 - a. Manufacturer's information, including list of spare parts.
 - b. Name, address, and telephone number of installer or supplier.
 - c. Maintenance procedures.
 - d. Maintenance and service schedules for preventive and routine maintenance.
 - e. Maintenance record forms.
 - f. Sources of spare parts and maintenance materials.
 - g. Copies of maintenance service agreements.
 - h. Copies of warranties and bonds.
- B. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.
- C. Provide an electronic copy of the entire Operation and Maintenance Manual.

1.10 PROJECT RECORD DOCUMENTS

- A. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings.
 - 1. Mark Record Prints to show the actual installation where installation varies from that shown originally.

2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
 3. Mark important additional information that was either shown schematically or omitted from original Drawings.
 4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.
 5. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
- B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
- C. Record Product Data: Submit one copy of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All materials and equipment used in the construction of the project shall be new unused and undamaged unless otherwise specified. Materials and equipment shall be of latest design standards of manufacturer specified.
- B. Materials and equipment are limited by the requirements of the contract documents. Material and equipment shall be provided in accordance with the following:
1. Basis of Design Products: Basis of Design Products are those products around which the project was designed in terms of capacity, performance, physical size and quality. Basis of Design Products shall be provided unless substitutions are made in accordance with this specification.
 2. Substitutions: Substitutions are product of manufacturers other than listed as Basis of Design. Substitutions shall meet each of the following requirements:
 - a. The product shall be manufactured by one of the acceptable manufacturers listed in the contract documents.
 - b. The product shall meet or exceed the requirements of the contract documents in terms of quality, performance, suitability, appearance and characteristics.
 - c. The contractor providing the substitution shall bear the total cost of all changes due to substitutions. These may include but are not limited to redesign costs and increased work by other contractors or the owner.
 - d. The Architect/Engineer shall be the sole judge of the suitability of the substitution items.
- C. Verify installation details and requirements for materials and equipment furnished by others and installed under this contract.

PART 3 - EXECUTION

3.1 DEMONSTRATION AND TRAINING

- A. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
1. Provide instructors experienced in operation and maintenance procedures.

2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
3. Schedule training with Owner and Architect/Engineer with at least seven days' advance notice.

B. Program Structure. Include instruction for the following:

1. System design and operational philosophy.
2. Review of documentation.
3. Operations.
4. Adjustments.
5. Troubleshooting.
6. Maintenance.
7. Safety.

3.2 STARTING AND ADJUSTING

- A. Start and test all equipment and operating components to confirm proper operation. Test and adjust all systems to achieve designed capacity and performance.
- B. Provide three (3) copies of all test report to the Architect/Engineer for review prior to date of substantial completion.
- C. All equipment and systems discrepancies shall be corrected prior to final acceptance.

MECHANICAL SUBMITTAL SCHEDULE

Refer to individual specification sections for additional requirements and detail on each submittal.

Section	Section Name	Product Data	Shop Dwgs	Test Reports / Quality Control	Warranty	Extra Materials	O&M Data	Record Docs	Demonstration / Training
210100	General Requirements for Fire Suppression	X	X	X	X				X
211000	Water-Based Fire-Suppression Systems	X	X			X	X		
220100	General Requirements for Plumbing	X	X		X				
220523	Valves for Plumbing	X					X		
220720	Pipe Insulation for Plumbing	X							
221116	Water Distribution Piping			X				X	
221316	Drainage and Vent Piping	X		X				X	
221319	Plumbing Specialties	X					X		X
230100	General Requirements for Mechanical Systems	X	X		X		X	X	X
230500	Basic Mechanical Materials and Methods	X	X				X		
230505	Basic Mechanical Piping Materials and Methods	X					X		
230523	Valves for HVAC	X					X		
230593	Testing, Adjusting, and Balancing			X					
230710	Equipment Insulation	X							
230720	Pipe Insulation for HVAC	X							
230900	HVAC Instrumentation and Controls	X	X	X	X		X	X	X
230960	Variable Frequency Drives	X	X			X	X		X
230993	Sequence of Operation for HVAC Controls		X	X			X	X	X
232113	Hydronic Piping	X		X			X	X	
232114	Below-grade Condenser Water Piping	X	X	X	X		X	X	
232123	Hydronic Pumps	X	X				X		X
232500	HVAC Water Treatment	X		X		X	X		X
235700	Heat Exchangers for HVAC	X	X	X	X		X		X
236500	Closed-circuit, Induced Draft, Counterflow Towers	X	X	X	X		X		X

END OF SECTION 23 01 00

SECTION 23 05 00 – BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following basic mechanical materials and methods and shall apply to all phases of the work specified, indicated on the drawings or required to provide for complete installation of mechanical systems.
 - 1. Indenting Devices and Labels
 - 2. Grout
 - 3. Sealants
 - 4. Access Doors
 - 5. Electrical Requirements
 - 6. Motors
 - 7. Mechanical Equipment Installation
 - 8. Labeling and Identifying
 - 9. Demolition
 - 10. Work in Existing Buildings
 - 11. Construction Layout
 - 12. Data and Measurements

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to ambient outdoor temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SUBMITTALS

- A. Product Data: For sealants and identification materials and devices.

- B. Shop Drawings: Detail fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.
- C. See "Submittal Schedule" at the end of Section 23 01 00 "General Requirements for Mechanical Systems."

1.5 QUALITY ASSURANCE

- A. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
- B. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design and commissioning requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Each contractor shall make provisions for delivery and safe storage of materials. Materials shall be delivered in a timely manner to expedite the work.
- B. Protect stored piping, supplies and equipment from cold, moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

1.7 COORDINATION

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for pipe, duct and equipment spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces.
- G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.
- H. See M0.0 Coversheet for Mechanical/Electrical Equipment Coordination Table.

PART 2 - PRODUCTS

2.1 IDENTIFYING DEVICES AND LABELS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 23 Sections. If more than one type is specified for application, selection is Installer's option, but provide one selection for each product category.
- B. Equipment Nameplates: Metal nameplate with operational data engraved or stamped; permanently fastened to equipment.
 - 1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.
 - 2. Location: Accessible and visible location.
- C. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated.
 - 1. Fabricate in sizes required for message.
 - 2. Engraved with engraver's standard letter style, of sizes and with wording to match equipment identification.
- D. Fasteners: Self-tapping stainless-steel screws or contact-type permanent adhesive.
- E. Valve Tags: 19 gauge, 1-1/2" diameter, polished brass, stamped or engraved 1/4" high piping system abbreviation in and 1/2" high sequenced valve numbers.
 - 1. Valve tag fastener: Solid brass wire link or beaded chain, or 'S'-hook or size required for proper attachment of tags to valves.
- F. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap on, color-coded, complying with ASME A13.1.
- G. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl, complying with ASME A13.1.
- H. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification, with corresponding designations indicated. Use numbers, lettering, and wording indicated for proper identification and operation/maintenance of mechanical systems and equipment.

2.2 GROUT

- A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
 - 1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psig, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.3 SEALANTS

- A. Polyurethane Sealant: Single component, chemical curing, non-staining, non-bleeding, capable of continuous water immersion, non-sagging for application in vertical and horizontal joints. Color as selected by architect.
- B. Accessories: Primer, joint cleaner, joint backing and bond breaker as recommended by sealant manufacturer to suit application.

- C. Firestopping Materials: Provide firestopping material to maintain required rating of all fire-resistive assemblies according to requirements of "Firestopping" section of this specification.

2.4 ELECTRICAL REQUIREMENTS

A. Compliance for HVAC Equipment

1. Comply with applicable requirements of the National Electric Code (NFPA 70)
2. Provide equipment and accessories that are listed and labeled as defined in NFPA 70
3. Comply with applicable requirements of Underwriters Laboratory (UL)
4. Comply with applicable requirements of NEMA standards

B. Electrical Wire

1. Wiring material shall be in accordance with the latest version of the National Electric Code (NFPA 70) and all applicable local codes and carry the UL label where applicable.
2. All exposed wiring in return air plenums shall be rate cable for fire and smoke spread.

2.5 MOTORS

A. BASIC MOTOR REQUIREMENTS

1. Motors $\frac{3}{4}$ HP and Larger shall be polyphase when available from the electrical service. Motors Smaller than $\frac{3}{4}$ HP shall be single phase unless otherwise indicated.
2. Frequency Rating shall be 60 Hz. Voltage Rating is determined by voltage of circuit to which motor is connected.
3. Service Factor: According to NEMA MG 1, unless otherwise indicated.
4. Capacity and Torque Characteristics: Rated for continuous duty and sufficient to start, accelerate, and operate connected loads at designated speeds, in indicated environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
5. Enclosure: Open dripproof, unless otherwise indicated.

B. POLYPHASE MOTORS

1. General
 - a. Design Characteristics: NEMA MG 1, Design B, Energy-Efficient Design, unless otherwise indicated.
 - b. Stator: Copper windings, unless otherwise indicated. Multispeed motors have separate winding for each speed.
 - c. Rotor: Squirrel cage, unless otherwise indicated.
 - d. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.
 - e. Temperature Rise: Match insulation rating, unless otherwise indicated.
 - f. Insulation: Class F, unless otherwise indicated.
2. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for indicated controller, with required motor leads brought to motor terminal box to suit control method.
3. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer. Inverter rated motors used in conjunction with variable speed drives shall be equipped with a shaft grounding ring. Grounding ring shall be Helwig Carbon Bearing Protector, installed per manufacturer requirements. Grounding ring may be epoxy mounted if manufacturer's recommended epoxy adhesive is used.

C. SINGLE-PHASE MOTORS

1. Permanent-split capacitor, Split-phase start, capacitor run or capacitor start, capacitor run as indicated or selected by manufacturer, to suit starting torque and other requirements of specific motor application.
2. Thermal Protection: Where indicated or required, internal protection automatically opens power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal protection device automatically resets when motor temperature returns to normal range, unless otherwise indicated.
3. Bearings: Ball-bearing type for belt-connected motors and other motors with high radial forces on motor shaft. Sealed, prelubricated sleeve bearings for other single-phase motors.

D. ELECTRONICALLY COMMUTATED MOTORS (ECM)

1. Permanent magnet type motor with near-zero rotor losses designed for synchronous rotation.
2. Brushless DC motor controlled by an integrated controller/inverter that operates the wound stator and senses rotor position to electrically commutate the stator as indicated or selected by manufacturer, to suit starting torque and other requirements of specific motor application. Coordinate input signal for speed with specific application.
3. Motor shall be designed to maintain a minimum 70 percent efficiency over the entire operating range.
4. Thermal Protection: Where indicated or required, internal protection automatically opens power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal protection device automatically resets when motor temperature returns to normal range, unless otherwise indicated.
5. Bearings: Sealed, pre-lubricated ball bearing type for poly-phase or single-phase motors.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. Install mechanical 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.
- E. Install equipment giving right of way to piping installed at required slope.

3.2 POSITION OF DEVICES

- A. Devices shall be installed at the height indicated below unless otherwise noted. All heights of outlets are measured from finished floor to centerline of device. Locate devices mounted on finish surfaces with regards to furring, trim, etc. Heights may be adjusted as necessary to clear wall mounted cabinets, electrical devices, etc. Where installed in masonry walls, mounting heights may be adjusted to correspond to block coursing. Where thermostats are located adjacent to light switches, match light switch mounting height. In no case shall devices requiring wheelchair accessibility be mounted above 48".
 1. Thermostats (where located adjacent to light switches, match light switch height) 48"
 2. Space Sensors (where located adjacent to light switches, match light switch height) 48"

3. Temperature Control Panels (not requiring occupant interface)

60"

3.3 LABELING AND IDENTIFY

- A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
1. Plastic markers, with application systems. Install on insulation segment if required for hot, uninsulated piping.
 2. Locate pipe markers as follows if piping is exposed in finished spaces, machine rooms, and accessible maintenance spaces, such as shafts, tunnels, plenums, and exterior nonconcealed locations:
 - a. Near each valve and control device.
 - b. Near each branch, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, if flow pattern is not obvious.
 - c. Near locations if pipes pass through walls, floors, ceilings, or enter nonaccessible enclosures.
 - d. At access doors, manholes, and similar access points that permit view of concealed piping.
 - e. Near major equipment items and other points of origination and termination.
 - f. Spaced at maximum of 50-foot intervals along each run. Reduce intervals to 25 feet in congested areas of piping and equipment.
 - g. On piping above removable acoustical ceilings, except omit intermediately spaced markers.
- B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of mechanical equipment.
- C. Valve Tags:
1. Install valve tag at all valves in piping systems listed below
 - a. Domestic water (excluding individual fixture isolation valves)
 - b. Heat Pump Loop piping
 - c. Condenser water piping
 2. Provide reproducible set of drawings indicating all valve locations.
- D. Label duct access doors at fire and smoke damper locations per NFPA 90A.
- E. Adjusting: Relocate identifying devices as necessary for unobstructed view in finished construction.

3.4 FIRESTOPPING

- A. Apply firestopping to all duct and pipe penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly.

3.5 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 3-1/2" inches larger in both directions than supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psi, 28-day compressive-strength concrete and reinforcement

3.6 DEMOLITION

A. Definitions

1. Remove: Detach items from existing construction and legally dispose of off-site unless indicated to be removed and salvaged or removed and reinstalled.
2. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner as indicated.
3. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage; prepare for reuse; and reinstall where indicated.
4. Existing to Remain: Existing items of construction that are not to be removed.

B. Materials of Ownership

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

C. Utility Services and Building Systems

1. Disconnect, demolish, and remove Work specified in Division 21, 22, and 23 Sections.
2. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment in accordance with 40 CFR 82 and regulations of authorities having jurisdiction.
3. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location[and cleaned] and reinstalled in their original locations after selective demolition operations are complete.
4. Existing Services/Systems to Remain: Maintain utilities and building systems and equipment to remain and protect against damage during selective demolition operations.
 - a. Maintain fire-protection facilities in service during selective demolition operations.
5. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utilities and building systems serving areas to be selectively demolished.
 - a. Owner will arrange to shut off indicated utilities when requested by Contractor.
 - b. Arrange to shut off utilities with utility companies.
 - c. If disconnection of utilities and building systems will affect adjacent occupied parts of the building, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to those parts of the building.
 - d. Demolish and remove existing building systems, equipment, and components indicated on Drawings to be removed.
 - 1) Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2) Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - 3) Equipment to Be Removed: Disconnect and cap services and remove equipment and components.
6. Abandon existing building systems, equipment, and components indicated on Drawings to be abandoned in place.
 - a. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place. Cut and remove underground pipe a minimum of 2 inches beyond face of adjacent construction. Cap and patch surface to match existing finish.
 - b. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork and insulation and leave in place.

7. Remove and reinstall/salvage existing building systems, equipment, and components indicated on drawings to be removed and reinstalled or removed and salvaged:
 - a. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment and components; when appropriate, reinstall, reconnect, and make equipment operational.
 - b. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and components and deliver to Owner.
 8. If any mechanical piping, ductwork, insulation, or equipment not designated for demolition is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.
- D. Accessible Work: Remove indicated exposed pipe and ductwork in its entirety.
- E. Removal: Remove indicated equipment from Project site.
- F. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.
- G. Where wall mounted sensors, thermostats, panels, equipment, or similar are demolished, all resultant holes shall be filled and patched and the wall shall be painted to match adjacent construction. This includes associated hangers, covers, and accessories

3.7 WORK IN EXISTING BUILDINGS

- A. Full Owner Occupancy: The Owner will occupy the site and existing building during the construction period. Cooperate with the Owner to minimize conflicts with the Owner's operations.
- B. Schedule all work in advance with the owner. Do not proceed with work without the Owner's written approval.
- C. Notify Owner of noisy operations and schedule in advance.
- D. The Owner shall have the right to direct work to secure safe and proper progress and quality of work.
- E. Do not interrupt utilities without Owner's written approval of time and duration. Interruptions shall be minimum required for completion of work.
- F. The existing fire alarm system shall remain functional throughout the project. The Owner and the Fire Marshall shall approve required outages.
- G. The Owner shall be notified before starting welding or cutting. Fire extinguishers shall be immediately accessible when welding or cutting with an open flame or arc. Welding or cutting with an open flame or arc shall be stopped not less than one hour before leaving the premises.
- H. Existing mechanical items that interfere with the proper installation new work shall be removed or relocated as required or as directed by the Architect/Engineer.

3.8 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair cut surfaces to match adjacent surfaces.

3.9 CONSTRUCTION LAYOUT

- A. Layout work in advance of installation using data and measurements from the site, the appropriate architectural and structural drawings and shop drawings.
- B. Confirm adequate clearance for installation, operation, maintenance and code required clearance including items installed by other contractors.
- C. If layout to provide clearance is not possible, promptly notify Architect/Engineer for clarification.

3.10 DATA AND MEASUREMENTS

- A. The data given herein and on the drawings is as accurate as could be secured. The existence and location of construction as indicated is not guaranteed. Before beginning work investigate and verify the existence and location of items affecting work. Obtain exact locations, measurements, levels, etc., at the site and adapt work to actual conditions.
- B. Only site measurements may be utilized in calculations. Mechanical and electrical drawings are diagrammatic or schematic.

3.11 PAINTING AND FINISHING

- A. Refer to individual sections for paint materials, surface preparation, and application of paint.
- B. Do not paint piping specialties with factory-applied finish.
- C. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.12 HANGERS AND SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with applicable codes and standards.

3.13 GROUTING

- A. Install nonmetallic, non-shrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix and place and cure grout according to manufacturer's written instructions.

3.14 ACCESS

- A. Provide access to all equipment, valves, controls, etc. as required for operation, repair and maintenance.
- B. Access doors shall be provided when access through ceilings, chases, etc. is not provided by others.

3.15 ELECTRICAL WIRING

- A. Install all electrical wiring in accordance with the National Electric Code and Division 26 of this specification.
- B. All line voltage wire shall be installed in metal raceways.
- C. All low voltage wire in equipment rooms, concealed in walls, or exposed in space shall be installed in metal raceways.

END OF SECTION 23 05 00

SECTION 23 05 05 - BASIC MECHANICAL PIPING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following basic mechanical materials and methods to complement other Division 21, 22 and 23 Sections.
 - 1. Piping materials and installation instructions common to mechanical piping systems.
 - 2. Dielectric fittings.
 - 3. Flexible connectors.
 - 4. Mechanical sleeve seals.
 - 5. Escutcheons.
 - 6. Pipe hangers and supports
 - 7. Thermal Hanger Shield Inserts
 - 8. Thermometers
 - 9. Pressure Gages
 - 10. Test Plugs
 - 11. Meters
- B. Pipe and pipe fitting materials are specified in Division 23 piping system Sections.

1.3 DEFINITIONS

- A. MSS: Manufacturer's Standardization Society for the Valve and Fittings Industry.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

1.5 SUBMITTALS

- A. Product Data: For dielectric fittings, mechanical sleeve seals, and each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated. Include scale range, ratings, and calibrated performance curves for each meter, gage, fitting, specialty, and accessory specified.
- B. Maintenance Data: For meters and gages to include in maintenance manuals. Submit valve schedules to include in maintenance manuals for each piping system. Valve schedule shall indicate valve number, piping system and location of valve.

- C. See "Submittal Schedule" located at the end of Section 23 01 00 "General Requirements for Mechanical Systems."

1.6 QUALITY ASSURANCE

- A. Welders shall be qualified in accordance with applicable codes. Welding procedures and testing shall comply with ANSI B31.10 "Standard for Pressure Piping, Power Piping" and AWS Welding Handbook.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Dielectric Unions, Couplings, Flanges:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Co.
 - c. Eclipse, Inc.; Rockford-Eclipse Div.
 - d. Epco Sales Inc.
 - e. Hart Industries International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
2. Flexible Connectors:
 - a. Nexus Valve
 - b. Metraflex
 - c. Hays Fluid Controls
 - d. Flexicraft Industries
 - e. Pro Hydronic Specialties
 - f. Flex Weld Inc
3. Mechanical Sleeve Seals:
 - a. Calpico, Inc.
 - b. Metraflex Co.
 - c. Thunderline/Link-Seal.
4. Pipe Hangers and Supports:
 - a. AAA Technology and Specialties Co., Inc.
 - b. Anvil
 - c. B-Line Systems, Inc. by Eaton
 - d. Carpenter & Patterson, Inc.
 - e. Grinnell Corp. B-Line Systems, Inc.
 - f. Grinnell Corp.; Power-Strut Unit.
 - g. GS Metals Corp.
 - h. Michigan Hanger Co., Inc.; O-Strut Div.
 - i. National Pipe Hanger Corp.
 - j. Thomas & Betts Corp.
 - k. Unistrut Corp.
 - l. Wesanco, Inc.

- m. Thermal-Hanger Shield Inserts
- 5. Thermometers:
 - a. AMETEK, Inc.; U.S. Gauge Div
 - b. Dresser Industries, Inc.; Instrument Div.; Ashcroft Commercial Sales Operation.
 - c. Dresser Industries, Inc.; Instrument Div.; Weksler Instruments Operating Unit.
 - d. Ernst Gage Co.
 - e. Marshalltown Instruments
 - f. Miljoc Corporation
 - g. Noshok, Inc.
 - h. Reotemp Instrument Corp.
 - i. Tel-Tru Manufacturing Co., Inc.
 - j. Trerice: H. O. Trerice Co.
 - k. Weiss Instruments, Inc.
 - l. Winter's Thermogauges, Inc.
- 6. Pressure Gages:
 - a. AMETEK, Inc.; U.S. Gauge Div.
 - b. Dresser Industries, Inc.; Instrument Div.; Ashcroft Commercial Sales Operation.
 - c. Dresser Industries, Inc.; Instrument Div.; Weksler Instruments Operating Unit.
 - d. Ernst Gage Co.
 - e. Marsh Bellofram.
 - f. Miljoco Corporation
 - g. Noshok, Inc.
 - h. Trerice: H. O. Trerice Co.
 - i. Weiss Instruments, Inc.
 - j. WIKA Instruments Corp.
 - k. Winter's Thermogauges, Inc.
- 7. Test Plugs:
 - a. Flow Design, Inc.
 - b. MG Piping Products Co.
 - c. Miljoco Corporation
 - d. National Meter.
 - e. Peterson Equipment Co., Inc.
 - f. Sisco Manufacturing Co.
 - g. Trerice: H. O. Trerice Co.
 - h. Watts Industries, Inc.; Water Products Div.

2.2 PIPE AND PIPE FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32.
1. Alloy Sn95 or Alloy Sn94: Approximately 95 percent tin and 5 percent silver, with 0.10 percent lead content.
 2. Alloy E: Approximately 95 percent tin and 5 percent copper, with 0.10 percent maximum lead content.
 3. Alloy HA: Tin-antimony-silver-copper zinc, with 0.10 percent maximum lead content.
 4. Alloy HB: Tin-antimony-silver-copper nickel, with 0.10 percent maximum lead content.
 5. Alloy Sb5: 95 percent tin and 5 percent antimony, with 0.20 percent maximum lead content.
- F. Brazing Filler Metals: AWS A5.8.
1. BCuP Series: Copper-phosphorus alloys.
 2. BAg1: Silver alloy.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts and nuts.
- I. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
1. Sleeve: ASTM A 126, Class B, gray iron.
 2. Followers: ASTM A 47 malleable iron or ASTM A 536 ductile iron.
 3. Gaskets: Rubber.
 4. Bolts and Nuts: AWWA C111.
 5. Finish: Enamel paint.

2.4 DIELECTRIC FITTINGS

- A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
- B. Description: Assembly or fitting of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- E. Dielectric Unions:

1. Standard: ASSE 1079.
2. Pressure Rating: 150 psig.
3. End Connections: Solder-joint copper alloy and threaded ferrous.

F. Dielectric Flanges:

1. Standard: ASSE 1079.
2. Factory-fabricated, bolted, companion-flange assembly.
3. Pressure Rating: 150 psig.
4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

G. Dielectric-Flange Insulating Kits:

1. Nonconducting materials for field assembly of companion flanges.
2. Pressure Rating: 150 psig.
3. Gasket: Neoprene or phenolic.
4. Bolt Sleeves: Phenolic or polyethylene.
5. Washers: Phenolic with steel backing washers.

H. Dielectric Nipples:

1. Standard: IAPMO PS 66.
2. Electroplated steel nipple, complying with ASTM F 1545.
3. Pressure Rating: 300 psig at 225 deg F.
4. End Connections: Male threaded or grooved.

I. Lining: Inert and noncorrosive, propylene.

2.5 FLEXIBLE CONNECTORS

A. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

B. Spherical, Rubber, Flexible Connectors:

1. Body: Fiber-reinforced rubber body.
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
3. Performance: Capable of misalignment.
4. CWP Rating: 150 psig
5. Maximum Operating Temperature: 250 deg F

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

2.7 PIPING SPECIALTIES

- A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
1. Steel Sheet Metal: 0.0239-inch minimum thickness, galvanized, round tube closed with welded longitudinal joint.
 2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
 3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- B. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.
1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
 2. OD: Completely cover opening.
 3. Stamped Steel: One piece, with set screw, spring clips, concealed hinge and chrome-plated finish.

2.8 PIPE HANGERS AND SUPPORTS

- A. Pipe Hangers, Supports, and Components: factory-fabricated components.
1. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.
1. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

2.9 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psi or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100-psi, ASTM C552, Type II cellular glass with 100-psi or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength.
- C. Insulation-Insert Material for Refrigerant Piping (and hydronic piping insulated with EPDM or neoprene insulation): Polymeric core with surrounding EPDM foam rubber insulation and weatherproof outer membrane or PET core with neoprene insulation and PVC foil cladding.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe. Top half shall be standard pipe insulation.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.10 MISCELLANEOUS PIPE SUPPORTING MATERIALS

- A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- C. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- D. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.

2.11 THERMOMETERS, GENERAL

- A. Scale Range: Temperature ranges for services listed are as follows:
 - 1. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions.
 - 2. Condenser Water: 0 to 160 deg F, with 2-degree scale divisions.
 - 3. Heat Pump Loop Water: 0 to 160 deg F with 2-degree scale divisions.
- B. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

2.12 LIQUID-IN-GLASS THERMOMETERS

- A. Case: Die-cast aluminum with hard powder-coat finish, acrylic front, 9 inches long.
- B. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.
- C. Tube: Blue reading, organic-liquid filled with magnifying lens.
- D. Scale: Satin-faced nonreflective aluminum with permanently etched markings or white finished aluminum with black markings.
- E. Stem: Die-cast aluminum for separable socket; of length to suit installation.

2.13 DIRECT-MOUNTING, FILLED-SYSTEM DIAL THERMOMETERS

- A. Description: Vapor-actuated, universal-angle dial type.
- B. Case: Stainless steel with 4-1/2-inch diameter, clear acrylic lens.
- C. Adjustable Joint: Brass, 180-degree adjustment in vertical plane, with locking device.
- D. Thermal Bulb: Copper with phosphor-bronze bourdon pressure tube.
- E. Movement: Brass, precision geared.
- F. Scale: Progressive, white finished aluminum with black markings.
- G. Stem: Copper for separable socket; of length to suit installation.

2.14 SEPARABLE SOCKETS (THERMOWELLS)

- A. Description: Fitting with protective socket for installation in threaded pipe fitting to hold fixed thermometer stem.
 - 1. Material: to match piping.
 - 2. Extension-Neck Length: Nominal thickness of 2 inches, but not less than thickness of insulation. Omit extension neck for sockets for piping not insulated.
 - 3. Insertion Length: To extend to one-third of diameter of pipe or 2 inches into pipe.

2.15 PRESSURE GAGES

- A. Description: ASME B40.1, phosphor-bronze bourdon-tube type with bottom connection; dry type, unless liquid-filled-case type is indicated.
- B. Case: Stainless steel with 4-1/2-inch diameter, clear acrylic lens.
- C. Connector: Brass, NPS 1/4.
- D. Scale: White-coated aluminum with permanently etched markings or white finished aluminum with black markings.
- E. Accuracy: Grade 1A, plus or minus 1 percent of full scale.
- F. Range: Comply with the following:
 - 1. Vacuum: 30 inches Hg of vacuum to 15 psig of pressure.
 - 2. Fluids under Pressure: Two times the operating pressure.
- G. Gage Fitting Valves: NPS 1/4 brass or stainless-steel needle type.

2.16 TEST PLUGS

- A. Description: Brass-body test plug in NPS 1/2 fitting.
- B. Body: Length as required to extend beyond insulation.
- C. Pressure Rating: 500 psig minimum.
- D. Core Inserts: Two self-sealing valves, suitable for inserting 1/8-inch OD probe from dial-type thermometer or pressure gage adapter with probe.
- E. Core Material for Air and Water: Nordel, good up to 350 deg F.
- F. Core material for Natural Gas: Neoprene, good up to 200 deg F.
- G. Test-Plug Cap: Gasketed and threaded cap, of same material as plug.
- H. Test Kit: Pressure gage and adapter with probe, two 5-inch pocket testing thermometers with magnifying lens, and protective carrying case.
 - 1. Pressure Gage and Thermometer Ranges: Approximately two times the system's operating conditions.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General: Install piping as described below, unless piping Sections specify otherwise. Individual Division 21, 22 and 23 piping Sections specify unique piping installation requirements.
- B. General Locations and Arrangements: 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.
- C. Install piping at indicated slope.
- D. Install components with pressure rating equal to or greater than system operating pressure.
- E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- F. Install piping free of sags and bends.
- G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- I. Install piping to allow application of insulation plus 1-inch clearance around insulation.
- J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- K. Install fittings for changes in direction and branch connections.
- L. Install couplings according to manufacturer's written instructions.
- M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings.
- N. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Build sleeves into new walls and slabs as work progresses.
 - 3. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
- O. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- P. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping materials

- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- T. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
 - 1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 - 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 - 3. Soldered Joints: Construct joints according to AWS's "Soldering Manual," Chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook."
 - 4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 5. 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:
 - 6. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.
 - 7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
 - 8. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to manufacturer's recommendations.
- U. Piping Connections: Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping 2-inch NPS and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS or smaller threaded pipe connection.
 - 2. Install flanges, in piping 2-1/2-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
 - 3. Install dielectric unions and flanges to connect piping materials of dissimilar metals.

3.2 HANGER AND SUPPORT APPLICATIONS

- A. Comply with MSS SP-69 for pipe hanger selections and applications.
- B. Comply with MSS SP-89 for fabrication and installation procedures.
- C. Horizontal-Piping Hangers and Supports: Use swivel ring or clevis type hangers.
- D. Vertical-Piping: Use riser clamps.
- E. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - b. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

- a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
- 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
- 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 HANGER AND SUPPORT INSTALLATION

- A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems. Field assemble and install according to manufacturer's written instructions.
- C. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.
- D. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- E. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- F. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- G. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- H. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Support vertical piping and tubing at base and at each floor.
- L. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:
1. 3/4-Inch NPS and Smaller: Maximum horizontal spacing, 60 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 2. 1-Inch NPS: Maximum horizontal spacing, 72 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 3. 1-1/4-Inch NPS: Maximum horizontal spacing, 72 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 4. 1-1/2 and 2-Inch NPS: Maximum horizontal spacing, 96 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 5. 2-1/2-Inch NPS: Maximum horizontal spacing, 108 inches with 1/2-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 6. 3-Inch NPS: Maximum horizontal spacing, 10 feet with 1/2-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 7. 4- and 5-Inch NPS: Maximum horizontal spacing, 10 feet with 1/2-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 8. 6-Inch NPS: Maximum horizontal spacing, 10 feet with 5/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 9. 8-Inch NPS: Maximum horizontal spacing, 10 feet with 3/4-inch minimum rod diameter; maximum vertical spacing, 10 feet.
- M. Install hangers for steel, cast and ductile-iron piping with the following maximum spacing and minimum rod diameters:
1. 1-1/4-Inch NPS and Smaller: Maximum horizontal spacing, 84 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 2. 1-1/2-Inch NPS: Maximum horizontal spacing, 108 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 3. 2-Inch NPS: Maximum horizontal spacing, 10 feet with 3/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 4. 2-1/2-Inch NPS: Maximum horizontal spacing, 11 feet with 1/2-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 5. 3-Inch NPS: Maximum horizontal spacing, 12 feet with 1/2-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 6. 4- and 5-Inch NPS: Maximum horizontal spacing, 12 feet with 5/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 7. 6-Inch NPS: Maximum horizontal spacing, 12 feet with 3/4-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 8. 8- through 12-Inch NPS: Maximum horizontal spacing, 12 feet with 7/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
- N. Pipe Stand Installation:
1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.

3.4 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
- D. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.5 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors where indicated on drawings.
- B. Install connectors in strict accordance with manufacturer installation instructions

3.6 METER AND GAGE INSTALLATION, GENERAL

- A. Install meters, gages, and accessories according to manufacturer's written instructions for applications where used.
- B. Install meters and gages adjacent to machines and equipment to allow service and maintenance.
- C. Calibrate meters and gauges according to manufacturer's written instructions, after installation

3.7 THERMOMETER INSTALLATION

- A. Install thermometers and adjust vertical and tilted positions.
- B. Install thermometers at locations indicated on plans and at the following locations:
 - 1. Inlet and outlet of each hydronic heat exchanger.
- C. Install separable sockets in vertical position in piping tees where fixed thermometers are indicated.
- D. When thermometers are installed in piping 1" and smaller, install well in 1-1/4" with reducers to prevent restriction of flow.

3.8 PRESSURE-GAGE INSTALLATION

- A. Install pressure gages in piping tees with pressure-gage valve located on pipe at most readable position.
- B. Install pressure gages at locations indicated on plans and at the following locations:
 - 1. Discharge of each pressure-reducing valve.
 - 2. Install liquid-filled-type pressure gages at suction and discharge of each pump.

END OF SECTION 23 05 05

SECTION 23 05 23 – VALVES 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 DEFINITIONS

- A. CWP: Cold working pressure.

1.3 SUMMARY

- A. This Section includes general duty valves common to several mechanical piping systems. Special purpose valves are specified in Division 23 piping system Sections.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.
- C. Maintenance data for valves to include in the operation and maintenance manual specified in Division 01. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.
- D. See Submittal Schedule located at the end of Section 23 01 00 "General Requirements for Mechanical Systems."

1.5 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ball Valves:
 - a. Conbraco Industries, Inc.; Apollo Division.
 - b. Hammond Valve Corporation.
 - c. Milwaukee Valve Company, Inc.

- d. NIBCO Inc.
- e. Stockham Valves & Fittings, Inc.
- f. Tyler Pipe.
- g. Victaulic Company of America.

2. Butterfly Valves:

- a. Center Line, Mark Controls Corporation.
- b. Crane Company; Valves and Fitting Division.
- c. General Signal; DeZurik Unit.
- d. Grinnell Corp.
- e. Hammond Valve Corporation.
- f. Keystone Valve USA, Inc.
- g. Milwaukee Valve Company, Inc.
- h. NIBCO Inc.
- i. Red-White Valve Corp.
- j. Stockham Valves & Fittings, Inc.
- k. Tyler Pipe.
- l. Ultraflo Corporation.
- m. Victaulic Company of America.

3. Check Valves:

- a. Cla-Val Co.
- b. Conbraco Industries, Inc.; Apollo Division.
- c. Hammond Valve Corporation.
- d. Keystone Valve USA, Inc.
- e. Kitz Corp. of America.
- f. Metraflex Company.
- g. Milwaukee Valve Company, Inc.
- h. NIBCO Inc.
- i. Red-White Valve Corp.
- j. Stockham Valves & Fittings, Inc.
- k. Tyler Pipe.
- l. Val-Matic Valve & Mfg. Corp.
- m. Victaulic Company of America.

2.2 BASIC, COMMON FEATURES

- A. Pressure and Temperature Ratings: As indicated in the "Application Schedule" of Part 3 of this Section and as required to suit system pressures and temperatures.
- B. Sizes: Same size as upstream pipe, unless otherwise indicated.
- C. Operators: Use specified operators and handwheels, except provide the following special operator features:
 - 1. Handwheels: For valves other than quarter turn.
 - 2. Lever Handles: For quarter-turn valves 6 inches and smaller.
 - 3. Chain-Wheel Operators: For valves 4 inches and larger, exposed in mechanical rooms and installed 96 inches or higher above finished floor elevation.
 - 4. Gear-Drive Operators: For quarter-turn valves 8 inches and larger.
 - 5. Memory Stops: For balancing applications.
- D. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

- E. Threads: ASME B1.20.1.
- F. Flanges: ASME B16.1 for cast iron, ASME B16.5 for steel, and ASME B16.24 for bronze valves.
- G. Solder Joint: ASME B16.18.

2.3 BALL VALVES

- A. Ball Valves, 4 Inches and Smaller: MSS SP-110, Class 150, 600-psi CWP, ASTM B 584 bronze body and bonnet, 2-piece construction; chrome-plated brass ball, standard port for 1/2-inch valves and smaller and conventional port for 3/4-inch valves and larger; blowout proof; bronze or brass stem; teflon seats and seals; threaded or soldered end connections, lever handle operator.

2.4 BUTTERFLY VALVES

- A. Butterfly Valves: MSS SP-67, 200-psi CWP, 150-psi maximum pressure differential, ASTM A 126 cast-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals, wafer, lug, or grooved style, nickel-plated ductile iron, disk per application.

2.5 CHECK VALVES

- A. Swing Check Valves, 2-1/2 Inches and Smaller: MSS SP-80; Class 125, 200-psi CWP, or Class 150, 300-psi CWP; horizontal swing, Y-pattern, ASTM B 62 cast-bronze body and cap, rotating bronze disc with rubber seat or composition seat, threaded or soldered end connections:
- B. Swing Check Valves, 3 Inches and Larger: MSS SP-71, Class 125, 200-psi CWP, ASTM A 126 cast-iron body and bolted cap, horizontal-swing bronze disc, flanged or grooved end connections.
- C. Wafer Check Valves: Class 125, 200-psi CWP, ASTM A 126 cast-iron body, bronze disc/plates, stainless-steel pins and springs, Buna N seals, installed between flanges.
- D. Lift Check Valves: Class 125, ASTM B 62 bronze body and cap (main components), horizontal or vertical pattern, lift-type, bronze disc or Buna N rubber disc with stainless-steel holder threaded or soldered end connections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.
- D. Examine threads on valve and mating pipe for form and cleanliness.

- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

- A. Install valves as indicated, according to manufacturer's written instructions.
- B. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
- C. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
- D. Locate valves for easy access and provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the center of the pipe.
- F. Install valves in a position to allow full stem movement.
- G. For chain-wheel operators, extend chains to 60 inches above finished floor elevation.
- H. Installation of Check Valves: Install for proper direction of flow as follows:
 - 1. Swing Check Valves: Horizontal position with hinge pin level.
 - 2. Wafer Check Valves: Horizontal or vertical position, between flanges.
 - 3. Lift Check Valve: With stem upright and plumb.

3.3 VALVE END SELECTION

- A. Select valves with the following ends or types of pipe/tube connections:
 - 1. Copper Tube Size, 2-1/2 Inches and Smaller: Solder ends.
 - 2. Steel Pipe Sizes, 2-1/2 Inches and Smaller: Threaded or grooved end.
 - 3. Steel Pipe Sizes, 3 Inches and Larger: Grooved end or flanged.

3.4 APPLICATION SCHEDULE

- A. General Application: Use ball and butterfly valves for shutoff duty; ball and butterfly valves for throttling duty. Refer to piping system Specification Sections for specific valve applications and arrangements.
- B. Heat Pump Loop Water Systems: Use the following valve types:
 - 1. Ball Valves: Class 150, 600-psi CWP, with stem extension and memory stop.
 - 2. Butterfly Valves: Nickel-plated ductile iron, aluminum bronze, or epoxy-coated ductile iron disc; EPDM or Buna N sleeve and stem seals.
 - 3. Bronze Swing Check: Class 150, with composition seat.
 - 4. Check Valves: Iron swing, wafer, or lift type, as indicated. Swing check shall be Class 150 with bronze seat ring.

C. Condenser Water Systems: Use the following valve types:

1. Ball Valves: Class 150, 600-psi CWP, with memory stop.
2. Butterfly Valves: Aluminum bronze, epoxy-coated ductile iron disc; EPDM sleeve and stem seals.
3. Check Valves: Class 125, bronze body swing check with rubber seat; Class 125, cast-iron body swing check; Class 125, cast-iron body wafer check; or Class 125, cast-iron body lift check.

3.5 ADJUSTING

- A. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

END OF SECTION 23 05 23

SECTION 23 05 53 – IDENTIFICATION FOR MECHANICAL 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.

1.2 SUMMARY

- A. This Section includes the following:

- 1. Equipment labels.
- 2. Pipe labels.
- 3. Valve tags.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:

- 1. Preparation instructions and recommendations.
- 2. Storage and handling requirements and recommendations.
- 3. Installation methods.

- B. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for HVAC equipment, piping, valve and duct identification.

- 1. Equipment Label Schedule: Provide a schedule of all equipment to be labeled with the proposed content for each label.
- 2. Pipe Label Schedule: Provide a schedule of each piping system indicating a proposed nomenclature and location of all pipe markers.
- 3. Valve Tag Schedule: Provide a proposed valve numbering scheme and schedule for each piping system. Tabulate valve number, piping system, system abbreviation as shown on tag, room or space location of valve, normal-operating position (open, closed, or modulating), and variations for identification. Mark valves intended for emergency shut-off and similar special uses.

- C. Closeout Submittals: Record actual as built locations of valve tags and update schedules accordingly.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience
- B. Installer Qualifications: Company specializing in performing Work of this section with minimum five years documented experience.
- C. ASME Standards: Comply with ASME A13.1 for color scheme, lettering size, length of color field, and viewing angles of identification devices.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady
2. Emed
3. Marking Services, Inc.
4. Seton Name Plate Co.

2.2 MECHANICAL IDENTIFICATION GENERAL

A. General: Provide manufacturer's standard products of categories and types required for each application specified. For each identification type, provide all products from same manufacturer with same text, style, color, shape, and other identification features.

1. Provide nameplates with the unit number on all mechanical equipment.
2. Provide pipe identification labels including direction-of-flow arrows and with service indicated. All labels shall have background colors matched with specific service designation.
3. Provide valve tag numbers on HVAC piping valves.
4. Provide duct identification labels including direction-of-flow arrows and with service indicated. All labels shall have background colors matched with specific service designation.

2.3 EQUIPMENT LABELS

A. Plastic Labels for Equipment (Indoor Application):

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware. Labels for outdoor use shall include UV coating.
2. Letter Color: White
3. Background Color: Black
4. Minimum Label Size: Length and width vary for required label content, but not less than 1 by 3 inches.
5. Minimum Letter Size: 1/4 inch.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's drawing designation or unique equipment number.

2.4 PIPE LABELS (INDOOR PIPING)

- A. Provide labels for above ground piping located indoors, and not exposed to sunlight or a harsh environment.
- B. Pre-printed, color-coded, with lettering indicating service, and showing flow direction.
- C. Lettering shall be sub-surface printed and protected from direct contact by a layer of plastic. Markers with surface printed lettering will not be accepted.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

- E. Pipe Labels for pipe O.D. less than 8 inches: Coiled, semi rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive in contact with the pipe surface.
- F. Pipe Labels for pipe O.D. 8 inches and over: Strap-on, semi rigid plastic to cover partial circumference of pipe and to attach to pipe with nylon ties

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4 inch letters for piping abbreviation and 1/2 inch numbers.
 - 1. Tag Material: Brass, 0.032 inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Background Color: Natural brass.
 - 3. Letter Color: Black.
 - 4. Tag Size: 1-1/2 inches, round.
 - 5. Fasteners: Brass S-Hooks and Jack Chain.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Install identifying devices after completion of coverings and painting.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. For labels that are installed using pressure-sensitive adhesives, clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.
- C. For pipe markers that are pre-coiled or strap-on type and do not adhere directly to the piping, no surface preparation is necessary.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Equipment Labels:
 - 1. Install or permanently fasten labels on each major item of mechanical equipment.
 - 2. Locate equipment labels where accessible and visible.

- C. Pipe Labels: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
- D. Valve Tags: Install tags on all shut-off valves and control devices in piping systems, except valves within factory-fabricated equipment units.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives.

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.
- C. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- D. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- E. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- F. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.
- G. AABC: Associated Air Balance Council.
- H. AMCA: Air Movement and Control Association.
- I. NEBB: National Environmental Balancing Bureau.
- J. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.4 SUBMITTALS

- A. Quality-Assurance Submittals: Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.
- B. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.
- C. Sample Report Forms: Submit 2 sets of sample testing, adjusting, and balancing report forms.

- D. See Submittal Schedule located at the end of Section 23 01 00 "General Requirements for Mechanical Systems."

1.5 QUALITY ASSURANCE

- A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by either AABC or NEBB.
- B. Testing, Adjusting, and Balancing Conference: Meet with the Owner's and the Architect's representatives on approval of the testing, adjusting, and balancing strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of testing, adjusting, and balancing team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel.
- C. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
 - 2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.
- D. Testing, Adjusting, and Balancing Reports: Use testing, adjusting, and balancing Agent's standard forms approved by the Architect/Engineer.
- E. Instrumentation Type, Quantity, and Accuracy: As described in NEBB standards.
- F. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.6 PROJECT CONDITIONS

- A. Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.7 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.
- B. Perform testing, adjusting, and balancing after leakage and pressure tests on water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine equipment performance data, including pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- D. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- E. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- F. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- G. Examine air-handling equipment to ensure bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- H. Examine strainers for clean screens and proper perforations.
- I. Examine 3-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- J. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- K. Examine automatic temperature system components to verify proper operation.
- L. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.2 GENERAL TESTING AND BALANCING PROCEDURES

- A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
- C. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.3 FUNDAMENTAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare schematic diagrams of systems' "as-built" piping layouts.
- B. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 - 1. Open all manual valves for maximum flow.

2. Check expansion tank liquid level.
3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation and set at design flow.
5. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
6. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.4 HYDRONIC SYSTEMS' BALANCING PROCEDURES

- A. Determine water flow at pumps. Use the following procedures.
 1. Verify impeller size by operating the pump with the discharge valve closed. Verify with the pump manufacturer that this will not damage pump. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on the manufacturer's pump curve at zero flow and confirm that the pump has the intended impeller size.
 2. Check system resistance. With all valves open, read pressure differential across the pump and mark the pump manufacturer's head-capacity curve. Adjust pump discharge valve until design water flow is achieved.
 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on the pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
- B. Set calibrated balancing valves, if installed, at calculated presettings.
- C. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures.
- D. Measure the differential-pressure control valve settings existing at the conclusions of balancing.
- E. Balance systems with automatic 2- and 3-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.5 TEMPERATURE TESTING

- A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.6 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 1. Water Flow Rate: minus 5 to plus 5 percent.

3.7 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.

- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
- C. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.
 - 2. Name and address of testing, adjusting, and balancing Agent.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of testing, adjusting, and balancing Agent who certifies the report.
 - 10. Summary of contents.
 - 11. Notes to explain why certain final data in the body of reports vary from design values.
 - 12. Test conditions for fans and pump performance forms.
- D. System Diagrams: Include schematic layouts of hydronic distribution systems.
- E. Apparatus-Coil Test Reports: For apparatus coils, include the following:
 - 1. Coil Data: Include the following:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch.
 - f. Make and model number.
 - g. Face area in sq. ft..
 - h. Tube size in NPS.
 - i. Tube and fin materials.
 - j. Circuiting arrangement.
 - 2. Test Data: Include design and actual values for the following:
 - a. Airflow rate in cfm.
 - b. Air pressure drop in inches wg.
 - c. Water flow rate in gpm.
 - d. Water pressure differential in feet of head or psig.
- F. Heat-Exchanger/Converter Test Reports: For steam and hot-water heat exchangers, include the following:
 - 1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and type.
 - e. Model and serial numbers.
 - f. Ratings.
 - 2. Steam Test Data: Include design and actual values for the following:

- a. Inlet pressure in psig.
 - b. Condensate flow rate in lb/h.
- 3. Primary Water Test Data: Include design and actual values for the following:
 - a. Entering-water temperature in deg F.
 - b. Leaving-water temperature in deg F.
 - c. Entering-water pressure in feet of head or psig.
 - d. Water pressure differential in feet of head or psig.
 - e. Water flow rate in gpm.
- 4. Secondary Water Test Data: Include design and actual values for the following:
 - a. Entering-water temperature in deg F.
 - b. Leaving-water temperature in deg F.
 - c. Entering-water pressure in feet of head or psig.
 - d. Water pressure differential in feet of head or psig.
 - e. Water flow rate in gpm.
- G. Pump Test Reports: For pumps, include the following data. Calculate impeller size by plotting the shutoff head on pump curves.
 - 1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model and serial numbers.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
 - 2. Test Data: Include design and actual values for the following:
 - a. Static head in feet of head or psig.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.
 - f. Final discharge pressure in feet of head or psig.
 - g. Final suction pressure in feet of head or psig.
 - h. Final total pressure in feet of head or psig.
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.
- H. Instrument Calibration Reports: For instrument calibration, include the following:

1. Report Data: Include the following:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.8 ADDITIONAL TESTS

- A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION 23 05 93

SECTION 23 07 20 - PIPE INSULATION 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. This Section includes preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

1.3 SUBMITTALS

- A. Product Data: Include product data description, list of materials, thickness, density, k-values and r-values for each product type, locations, manufacturer's installation instructions, flames spread and smoke developed ratings.
- B. See "Submittal Schedule" located at the end of Section 23 01 00 "General Requirements for Mechanical Systems."

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Mineral-Fiber Insulation:
 - a. CertainTeed Manson.
 - b. Knauf FiberGlass GmbH.
 - c. Owens-Corning Fiberglas Corp.
 - d. Schuller International, Inc.
 - e. Johns Manville
 - 2. Flexible Elastomeric Thermal Insulation:
 - a. Armacell

- b. Armstrong World Industries, Inc.
- c. Rubatex Corp.

2.2 INSULATION MATERIALS

- A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
 - 1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
 - a. Nominal density is 2.5 lb/cu. Ft. or more.
 - b. Thermal conductivity (k-value) at 125 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less.
 - 2. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
 - a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
 - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
 - 3. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
 - 4. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
 - 5. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
- B. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Thermal conductivity (k-value) at 90 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less
 - 2. Adhesive: As recommended by insulation material manufacturer.
 - 3. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.
- C. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- D. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil- thick, high-impact, ultraviolet-resistant PVC.
 - 1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
 - 2. Adhesive: As recommended by insulation material manufacturer.
- E. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes. Comply with ASTM B 209, 3003 alloy, H-14 temper.
 - 1. Finish and Thickness: Smooth finish, 0.020 inch thick.
 - 2. Finish and Thickness: Corrugated finish, 0.020 inch thick.
 - 3. Finish and Thickness: Stucco-embossed finish, 0.020 inch thick.
 - 4. Finish and Thickness: Painted finish, 0.016 inch thick.
 - 5. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 - 6. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.

2.3 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, pre-sized a minimum of 8 oz./sq. yd, 4 inch tape width.
- B. Bands: 3/4 inch wide, materials compatible with jacket:
- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.

2.4 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.2 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- C. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- D. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- E. Apply insulation with the least number of joints practical.
- F. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- G. 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, clamps, and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
 - 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- H. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
- I. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- J. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- K. Apply insulation with integral jackets as follows:
1. Pull jacket tight and smooth.
 2. Circumferential Joints: Cover with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.
 4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
 5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
- L. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- M. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- N. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- O. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Division 07 for firestopping and fire-resistive joint sealers.
- P. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies.
- 3.3 MINERAL-FIBER INSULATION APPLICATION
- A. Apply insulation to straight pipes and tubes by securing each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.

- B. Apply preformed pipe insulation to outer diameter of pipe flange.
- C. Apply insulation to fittings and elbows as follows:
 - 1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 - 2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
 - 3. Cover fittings with standard PVC fitting covers.
- D. Apply insulation to valves and specialties as follows:
 - 1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 - 2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
 - 4. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.4 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
 - 1. Follow manufacturer's written instructions for applying insulation.
 - 2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- B. Apply pipe insulation to outer diameter of pipe flanges.
- C. Apply insulation to fittings and elbows as follows:
 - 1. Apply mitered sections of pipe insulation.
 - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- D. Apply insulation inserts at hangers and anchor locations.
 - 1. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- E. Apply insulation to valves and specialties as follows:
 - 1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
 - 2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

3.5 INSTALLATION OF FIELD-APPLIED JACKETS

- A. Where PVC jackets are indicated and for horizontal applications, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- B. Where aluminum 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.

3.6 INSULATION APPLICATION SCHEDULE

- A. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
 - 1. Flexible connectors.
 - 2. Vibration-control devices.
 - 3. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.
- B. See "PIPING INSULATION SCHEDULE" on Sheet M

END OF SECTION 23 07 20

SECTION 23 08 00 – COMMISSIONING FOR HVAC SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents

1. Drawings and general provisions of the contract apply to this Section.
2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

B. Section Includes

1. General requirements that apply to implementation of commissioning of HVAC systems, assemblies, and components

C. Related Sections:

1. Division 01 Section "General Requirements."
2. Division 22 Plumbing Sections (Domestic Hot Water Systems and Metering only)
3. Division 23 HVAC Sections.
4. Division 26 Electrical Sections (Metering, HVAC Coordination and Lighting Controls as required)

1.2 DESCRIPTION

- A. The purpose of commissioning is to ensure that the work has been completed as specified and that systems are functioning in the manner as described in any applicable specification sections or construction documents. The commissioning agent shall provide the owner with an unbiased, objective view of the system's installation, operation, and performance. The commissioning process does not eliminate or reduce the responsibility of the installing contractors to provide a finished product, installed and fully functional in accordance with the contract documents. It will assist operating staff training and familiarization with new systems and will serve as a tool to reduce post-occupancy system operational difficulty or failure.
- B. Commissioning is intended to enhance the quality of the systems operations and aid in the transfer of systems for use by the owner. The Commissioning agent shall be the leader of the commissioning process by planning and coordinating all commissioning activities in conjunction with the design professionals, construction manager, subcontractors, manufacturers, and equipment suppliers.
- C. The General Contractor, Mechanical Contractor, Electrical Contractor, Controls Contractor and all subcontractors shall be responsible for cooperating with the Commissioning Agent.
- D. The phases associated with commissioning are described below in Part 3. The phases generally are:
1. Phase One – Installation Verification via Shop drawing review, Field Observations, and reporting
 2. Phase Two – System Start-Ups, and documentation
 3. Phase Three – Functional Performance Testing and Training
- E. Operational staff training is essential to the commissioning process and may be selectively quality reviewed by the commissioning agent to ensure that staff is receiving proper training as outlined in the specifications and is tailored to the needs of the staff based on skill level.

1.3 SYSTEMS TO BE COMMISSIONED

A. Commissioning will be performed on the following:

1. Building automation system
2. All Mechanical Equipment and systems connected to, monitored by, or controlled by the Building Automation System.
3. Small Unitary equipment which provides heating or cooling in a “stand-alone” method not associated with the Building Automation system. Examples: Mini-split air conditioning units, and unmonitored unit heaters.

1.4 SUBMITTALS

- #### A.
- Startup Forms will be submitted to the commissioning agent upon completion. All specification sections in the 23 series which require a start-up report will also be provided to the commissioning agent.
- #### B.
- Shop Drawings for equipment being commissioned will be made available to the commissioning agent are described in Part 3 below.

1.5 RESPONSIBILITIES

A. General Contractor (GC)

1. Facilitate the coordination of the commissioning work as outlined by the CA, and with the assistance of the CA, ensure that all commissioning activities are being scheduled into the master construction schedule.
2. Provide access to all construction documents, addenda, change orders and approved submittals and shop drawings related to equipment to be commissioned to the CA.
3. Ensure that all subcontractors execute their commissioning responsibilities according to the Contract Documents, schedule, and resolve deficiencies reported in the commissioning software by the CA.
4. A representative of the GC shall attend a commissioning scoping meeting and other necessary meetings scheduled by the CA to facilitate the Commissioning process.
5. Ensure that equipment startup documentation is completed and submitted as required by the specifications.

B. Mechanical Systems Installers

1. The responsibilities of the HVAC mechanical contractor, during construction and acceptance phases are:
 - a. Provide startup and documentation for all HVAC equipment.
 - b. Coordinate the commissioning and mechanical installation schedules with the TAB contractor.
 - 1) Ensure that the coordinated schedule is included in the GC two-week look ahead.
 - c. Attend a commissioning scoping meeting and other meetings necessary to facilitate the Commissioning process.
 - d. The Commissioning Agent may request further documentation necessary for the commissioning process.
 - e. Contractors shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
 - f. Develop a full start-up and initial checkout plan using manufacturer's start-up procedures for all commissioned equipment.
 - 1) Documentation of startup and checkout shall include at a minimum:

- a) Approved TAB report
 - b) Completed and approved startup documentation
 - c) Completed point-to-point checkout documentation from controls contractor
 - g. Mechanical equipment with packaged controls shall have both startup and setup documentation submitted to CA for review and approval prior to startup.
 - 1) Provide all tools, adapters, and software required for the CA to complete Functional Performance Testing of mechanical equipment with packaged controls.
 - h. Correct deficiencies (differences between specified and observed performance) as interpreted by the CA.
 - i. Provide all tools, adapters, and software required for the CA to complete Functional Performance Testing.
 - j. Assist with seasonal testing as requested by the CA.
- C. Controls (Systems Installer) Contractor (CC):
- 1. The responsibilities of the controls contractor, during construction and acceptance phases are:
 - a. Submittals. The Controls Contractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications. They shall include:
 - 1) All interactions and interlocks with other systems.
 - 2) Detailed delineation of control between any packaged controls and the building automation system, listing what points the BAS monitors only and what BAS points are control points and are adjustable.
 - 3) Written sequences of control for packaged controlled equipment. (Equipment manufacturers' stock sequences may be included but will generally require additional narrative).
 - 4) Effects of power or equipment failure with all standby component functions.
 - 5) Provide a full points list of inputs, output, trending, and alarms for each point.
 - b. Assist and cooperate with the TAB contractor and CA.
 - c. Attend a commissioning scoping meeting and other meetings necessary to facilitate the Commissioning process.
 - d. The Commissioning Agent may request further documentation necessary for the commissioning process.
 - e. Contractors shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
 - f. Complete required Installation & Programming / Integration Progress checklist(s) within the commissioning software.
 - g. Correct deficiencies (differences between specified and observed performance) as interpreted by the CA.
 - h. Assist the CA with the functional testing of the controls system as specified for the controls contractor, when requested.
 - i. Provide full BAS/system access to the CA, including remote login capabilities, full admin rights, and full read-only programming access.
 - j. Provide all tools, adapters, and software required for the CA to complete Functional Performance Testing.
 - k. Assist with seasonal testing as requested by the CA.
- D. Commissioning Agent (CA):

1. The CA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The CA may assist with problem-solving non-conformance items or deficiencies, but ultimately that responsibility resides with the general contractor and the A/E.
 - a. The primary role of the CA is to develop tests and execute testing of the equipment in accordance with the documented design intent and in accordance with the Contract Documents.
 - 1) Contractor and all subcontractors shall provide all tools or the use of tools, software, and interface devices to start, checkout and functionally test equipment and systems.
2. Construction Phase:
 - a. Plan and conduct a commissioning scoping meeting.
 - b. Provides input to the GC to the overall project schedule.
 - 1) When Functional Field Testing can be conducted.
 - 2) When Functional Performance Testing can be conducted.
 - c. Perform site visits, as necessary, to observe component and system installations. Attend selected planning and job-site meetings to obtain information on construction progress. Review construction meeting minutes for revisions/substitutions relating to the commissioning process.
 - 1) Generate list of deficiencies for correction by installing contractors.
 - d. Provide a final commissioning report.

1.6 Functional field tests

- A. The objective of functional field testing is to demonstrate that equipment is installed and operating per contract documents. Equipment will be operated to confirm that the device and installation meets the intent of design.
 1. The Commissioning Authority will self-perform testing. Contractors will assist when requested.

1.7 FUNCTIONAL PERFORMANCE TESTS

- A. The objective of functional performance testing is to demonstrate that each system is operating according to the documented design intent and contract documents. Each system will be operated through all modes of operation as described in the contract documents and sequence of operation.
 1. The Commissioning Authority will self-perform testing. Contractors will assist when requested.
 2. System operation may need to be verified seasonally.

PART 2 - PRODUCTS

2.1 Commissioning software

- A. Commissioning software will be utilized for the commissioning and will be provided by the commissioning agent. Contractors are required to utilize the software as described in this specification to respond to tracked deficiencies.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Subcontractors shall be responsible for coordinating their work status with the commissioning agent so that testing can be performed in a timely manner, as per the project schedule.
- B. If the vendor provides specialized equipment, testing kits, or parts as part of the equipment, and those items are required for testing the equipment, they will be provided to the commissioning agent for their use.
- C. The Subcontractors shall provide to the Commissioning Agent, if requested, documentation of calibration of controls components. Documentation shall include dates, setpoints, calibration coefficients, control loop verification, and other data required to verify system check-out. Documentation shall be dated and initialed by field engineer or technician performing the work.

3.2 PHASE ONE - INSTALLATION VERIFICATION

- A. General Commissioning responsibilities:
 - 1. Shop Drawings: All shop drawing processes shall follow associated specification requirements. Contractors are asked to allow access to the commissioning agent to all shop drawings for equipment associated with the list noted in 1.3.A above. Whenever possible the commissioning agent will do a review of the shop drawing concurrently with the design engineer and commissioning comments will be provided to the design engineer for their selection of incorporation into the final review. If shop drawings have already been approved when the commissioning agent is engaged, the commissioning agent will be allowed access to all approved submittals.
 - a. Note: Special consideration will be given to the controls shop drawings. The Controls contractor will need their shop drawings approved as final by both the engineer and the commissioning agent before proceeding with the work. Commissioning Agent will be given a minimum of two weeks to review shop drawings and provide comments to both the engineer and the contractor.
 - 2. Field visits with report.
 - a. The commissioning agent will perform field visits/reviews as indicated by the pace of the construction. Photo documentation of the construction site will occur throughout the field reviews.
 - b. During the field review, the commissioning agent will review installation techniques, materials storage compliance, and general conformance to the design documents including any change orders or punch lists as they pertain to the commissioned equipment list in Section 1.3.A including any peripheral items and systems which serve this equipment. It remains the contractor's responsibility to ensure that all these items are in compliance with construction design documents and any applicable codes, however the commissioning agent will attempt to assist in identifying issues during this time.
 - c. Deficiencies noted will be documented and tracked in the commissioning software. The subcontractors shall correct any deficiencies and log their completion in the commissioning software before system start-up work proceeds.

3.3 PHASE TWO – SYSTEM START UP

- A. General Commissioning Responsibilities:
 - 1. It is the General Contractors' responsibility to ensure that no equipment of the owners is started and operated in a manner which could cause damage to the equipment. This includes startup of mechanical systems when

activities are still ongoing in the building which could jeopardize the integrity of the equipment. These activities include:

- a. Drywall sanding
 - b. Spray painting
 - c. Any construction activities which cause significant levels of airborne particles.
2. It is recommended that all the activities outlined above are completed before any mechanical systems are started up.
 3. The use of the owner's equipment for temporary heating or cooling is discouraged. Contractor to review the 01 series specification sections for requirements of the project as it relates to temporary heating and cooling needs. Approval of the owner must be provided in writing to the commissioning agent if permanent mechanical systems will be utilized for temporary heating and cooling and only if allowed by 01 specification sections.
 4. All start up reports for equipment listed in Section 1.3.A will be provided to the commissioning agent. See Section 1.5.B below for further information on start-up procedures. The completed and signed reports must then be submitted to the commissioning agent via the commissioning software.
 5. If the contractor is given permission to operate the owners' equipment for heating or cooling on a temporary basis, they will be responsible for maintaining said equipment and ensuring the temporary operation does not compromise the equipment or associated warranty in any way. The contractor will notify the owner and commissioning agent of the planned temporary operation and how the equipment will be protected (filtering strategies, alarming strategies, when the equipment will run, and who will be notified in emergencies)
 6. The installing Subcontractor shall commence with system start-up only after the commissioning agent, engineer, and owner have been notified. As a courtesy, two weeks' notice before startup of equipment is requested so that the owner and or the commissioning agent can attend if desired.
 7. It is the contractor's responsibility to keep any systems and equipment clean during all portions of the construction both before and after startup. Any system or equipment found in a dissatisfactory state due to lack of protection, planning, or following startup procedures, will be cleaned at the contractor's expense before owner acceptance.
 8. Testing and Balancing shall commence after the systems have been successfully started. Any issues identified during start up procedures will be corrected before that system or equipment is tested and balanced. It is expected that no testing and balancing will occur until all temporary protections that were put into place for construction are removed by the contractor so that proper testing can occur. No protections shall be removed for testing until the activities outlined in Section 3.5.A.1 have been completed.
 9. At the discretion of the owner and project manager monthly commissioning meetings may occur if significant coordination efforts or issues are observed and dictate the need for meeting as a group. Generally, meetings will not be held during the course of normal construction unless all parties agree they are necessary due to significant issues occurring, scheduling concerns, etc.
 10. At the commencement of the commissioning testing activities a "Kick off" meeting will be held to ensure all parties are aware of the process, utilizing the software, how issues will be assigned and how issues will be resolved and processed. Generally, the commissioning agent will work directly with the controls, mechanical, and test and balance contractors as needed to quickly resolve issues, however if the General requests all issues may be routed through them for them to re-assign as they deem appropriate.
 11. Commissioning meetings, when held, will be done with an online platform to minimize travel costs and time for all parties unless deemed necessary to be onsite. The meetings will be kept to a minimum amount of time and will be coordinated with the owner and the construction team to be as efficient as possible for the group. If

onsite meetings are required, they will be coordinated during a time that contractors are already present for other construction meetings to keep time commitment to a minimum.

3.4 PHASE THREE – TESTING (functional field and functional performance)

A. General Commissioning Timelines and responsibilities:

1. Functional Field Testing begins after approved startup of equipment and completion of controls point-to-point documentation.
2. **Functional field testing will be completed primarily by the commissioning agent**, but all necessary parties including the equipment manufacturer's designated representative, the mechanical contractor, the electrical contractor, and the controls contractor will be required to perform any troubleshooting and corrections required to address issues documented by the CA deficiencies list.
3. Functional Performance Testing begins after operational testing, adjusting, and balancing of the systems have been completed by the Subcontractors and associated reports submitted and approved by the engineer and commissioning agent. It is assumed if this work has been completed that all systems are operational, all controls are completed, and all mechanical work is complete to include correction of deficiencies documented during functional field testing.
4. **Functional performance testing will be completed primarily by the commissioning agent**, but all necessary parties including the equipment manufacturer's designated representative, the mechanical contractor, the electrical contractor, the testing and balancing contractor and the controls contractor will be required to perform any troubleshooting and corrections required to address issues documented by the CA deficiencies list.
5. The functional performance testing will allow the Commissioning Agent to observe, evaluate, and identify deficiencies, and document the systems and equipment performance over a wide range of load and functional levels. It is to be expected that the functional performance testing will not be fully completed until well into the first year of occupancy due to seasonal variations which must be observed.

- B. A functional performance test is required for each piece of equipment or system listed in Section 1.3.A above unless sampling of multiple identical or near identical units is allowed by the commissioning agent. Sampling quantities and strategies will be determined in conjunction with the owner.
- C. The commissioning agent will develop specific test procedures for each piece of equipment and system within the commissioning software. The contractors will have access to view all tests prior to execution for their review of feasibility, safety and equipment warranty and protection. The contractor shall notify the commissioning agent immediately of any concerns regarding the tests outlined.
- D. Functional performance testing is conducted **by the commissioning agent** for each system or piece of equipment. The air and water balancing is to be completed with the report submitted to the engineer and commissioning agent and any deficient items corrected before the functional performance testing can take place. Systems must be fully complete with all controls strategies in place and all trending and alarms required by the owner and contract documents in place prior to the testing. Contractors are responsible for notifying the commissioning agent when systems are ready for testing.
- E. The controls contractor at the beginning of the testing shall provide a programmer and installation technician on site for (4) hours (one half day). This time will be coordinated with the commissioning agent to be the first day of testing to ensure that all access and permissions have been put in place to allow the commissioning agent to perform the testing. A brief overview of the system graphics, how to override points properly, how to pull trending information and any other necessary training needed to perform the testing will be provided at that time to the commissioning agent and any commissioning team members.

F. Testing Requirements:

1. To perform the testing the commissioning agent will be provided an individual login to the controls front end interface and any other necessary VPN log in or access needed to access the building automation system both on site and remotely. The login provided will have sufficient permissions to allow the commissioning agent to manipulate points and perform overrides to allow for proper and thorough testing of the system.
2. All equipment will be checked for physical operation which matches what is shown in the building automation system and as required by the approved controls shop drawings. This will be referred to as "Functional Field Testing". The commissioning agent will perform at a minimum an in-person physical review of all filters, and manual control safeties (if applicable) for field verification of systems cleanliness and proper operation which matches what is displayed in the automation system.
3. Demonstration by the Testing and Balancing contractor that the Testing and Balancing report matches actual field conditions. A small sampling of outlets and devices may be selected for verification if the commissioning agent deems it necessary. If all values match within a reasonable tolerance of reported values, then no further verifications will occur. If values are found which do not match the report, then the Test and Balance contractor will be responsible for reviewing their entire balanced system and making any corrections.
4. Once the building automation has been cross checked with physical operation, the commissioning agent will perform the testing by utilizing the building automation system software and reviewing the performance as documented within the system, this will be referred to as "functional performance testing". Trends, setpoints, graphics, points, alarms, and programming will be reviewed in the automation system to ensure proper operation as outlined in the design documents. Access to the programming logic (read only) as written by the controls contractor will be required for proper assessment of the performance of the system. Any deficiencies will be noted and tracked in the commissioning software.
5. Functional performance testing may occur on site, but functional performance testing will also be done with remote access to the system by reviewing live data as well as all trend histories. It is imperative the controls contractor sets up all trending logic as required by the contract documents to allow assessment of the functionality of the system. Change of Value intervals may be used whenever appropriate (such as alarms or setpoints) to save space on data sets. Trending timelines for more critical items such as the Outside Air damper must be provided in as short of increments as the system can handle to allow for precise review of the operation of the system.
6. The controls contractor will be responsible for any building automation system deficiencies and will respond using the commissioning software when deficiencies have been corrected.
7. Some tests may need to be performed later, after substantial completion, due to seasonal testing or other site conditions. All seasonal testing will be performed within the first-year warranty period and contractors will be responsible for all corrections just as they would during the construction period.

G. Deficiencies

1. A deficiency is any condition in the installation or function of a piece of equipment or system that is not in compliance with the contract documents or does not perform properly.
2. When the deficiency is corrected the contractor shall notify the commissioning agent via the online commissioning software that the deficiency has been corrected and is ready for retesting.
3. The Contractor shall be responsible for the correction of any deficiencies and retesting at no extra cost to the owner. If a deficiency is identified the commissioning agent shall document the deficiency within the commissioning software. Deficiencies will be corrected by the responsible assigned contractor for that item and when complete will mark the issue "Ready for CxA Review" to indicate their corrections are complete.

H. Failure Rate/Stop Work

1. The CA is required to test any single piece of equipment or system a maximum of two times. If initial testing raises a deficiency, equipment will be tested a second time – CA has met their contractual requirement. If additional deficiencies are found following a second test, and subsequent tests are requested, the CA will need to be compensated for additional testing.
2. If after notifying the commissioning agent of their readiness for testing, any bulk equipment testing (floor level equipment) within the project is found to have a failure rate exceeding 10% of the sampled equipment, a letter will be generated calling to Stop Work of the commissioning testing. The letter will be sent to the owner, the general contractor and the subcontractors affected by the testing. The failure rate will be established by taking the total number of failed items divided by the total number of selected items to be tested.
3. Once the stop work letter is generated and delivered the commissioning agent will not commence work again on commissioning/testing until they are provided in writing a letter from the contractors stating that they are ready to begin the second round of testing of the system. If after commencing testing again the failure rate again is established at 10% or higher, a stop work notice will once again be generated and a written notice to continue will be required. After the second attempt resulting in stop work the CA will need to be compensated for additional testing.

I. Training:

1. Contractors will notify the commissioning agent while coordinating scheduling of training with the owner. The commissioning agent at their discretion may witness entire, or portions of, training to ensure quality.

END OF SECTION 23 08 00

SECTION 23 09 00 – HVAC DIRECT DIGITAL CONTROLS

PART 1 - GENERAL

1.1 PROJECT INTENT

- A. Westside High School has existing Trane Tracer front-end HVAC control system for majority of existing school. A KMC control system is being provided to control all new mechanical equipment associated with the Life Complex project. Preference for fluid cooler and associated equipment in this project to be controlled by KMC control system.

1.2 SECTION INCLUDES

- A. Furnish all labor, materials, equipment, and services for the installation of a complete Direct Digital Control System (DDC) as indicated, in accordance with provisions of the Contract Documents. Westside Community Schools shall contract independently for graphic programming and Front-End integration related to this project on the Tridium N4 Supervisor.
- B. Although such work is not specifically indicated, provide all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation.

1.3 RELATED SECTIONS

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents.
- B. The Owner will contract directly with the Commissioning Authority (CxA) for this project. All Contractors shall cooperate with the CxA to complete all required commissioning.

1.4 DESCRIPTION

- A. General:
 - 1. Westside Community Schools is using the Niagara N4 software as the "Front-End" interface to all buildings. All BAS equipment installed shall be compatible with Niagara N4. Westside Community Schools will separately contract the integration services for the Niagara Front End integration.
 - 2. All control system equipment, including sensors, transmitters, control modules and communication link wiring between controllers required for the installation shall be provided by the Temperature Control Contractor.
 - 3. The control systems shall be designed such that each mechanical system shall operate under stand-alone mode. The System Integrator administered by this Section of the technical specifications shall provide controllers for each mechanical system. In the event of a network communication failure, or the loss of any field controller, the control system shall continue to operate independently.
 - 4. Communication wiring shall be tested to demonstrate functional operation.
 - 5. All wiring and control hardware to be installed by the Temperature Control Contractor.
 - 6. Temperature Control Contractor to provide all labor incidental to the Building Automation System including engineering assistance, start-up, check-out and programming.
 - 7. Control valves and dampers to be furnished by the temperature control contractor and installed by Mechanical or Sheet metal contractor.
 - 8. The control system shall consist of a high-speed, peer-to-peer network of DDC controllers, a control system server, and a web-based operator interface.

- B. System software shall be based on a server/thin client architecture, designed around the open standards of web technology. The control system server shall be accessed using a Web browser over the control system network, the owner's local area network, and (at the owner's discretion) over the Internet. The intent of the thin-client architecture is to provide operators complete access to the control system via a Web browser. No special software other than a web browser shall be required to access point displays, and trends, configure trends, configure points and controllers, or to download programming into the controllers.
- C. System shall use the BACnet protocol for communication between control modules. I/O points, schedules, setpoints, trends and alarms specified in the Sequence of Operations for HVAC Controls shall be BACnet objects.

1.5 QUALITY ASSURANCE

- A. The following are the approved manufacturers of control equipment for this project, or their equivalent:
 - 1. KMC Controls
 - 2. Trane
 - a. Manufacturers of equivalent equipment may be submitted for approval by the Mechanical Engineer as per the requirements below.
- B. Other manufacturers' equipment may be proposed but must comply with the following specifications. To obtain bid approval, a detailed technical proposal shall be required of bidders and shall be furnished along with the bid. The information required shall list at least 3 similar digital transmission, computer oriented, integrated DDC installations which have been on-line for at least 5 years. The list shall include a synopsis of the type of control strategies being implemented, name of primary contact and phone number along with the local service capability. Technical cut sheets for all non-approved products being proposed shall also be provided. Cut sheets shall provide technical information and network requirements. Also provide cut sheets for any custom editing/programming software required for programming controllers.
- C. The BAS shall be installed by competent mechanics and checked out by competent technicians regularly employed by the manufacturer of the equipment.
- D. Single source responsibility of the Temperature Control Contractor shall include installations, calibration, and check out of systems.
- E. The Temperature Control Contractor shall have an in-place, local support facility with technical staff, spare parts inventory, and all necessary test diagnostic equipment.
- F. The Temperature Control Contractor shall employ Niagara Certified programmers with at least 5 years of programming experience. All JACE programming shall be done with a Niagara N4 certified programmer also regularly employed by the manufacturer or manufacturer representative. Certified Programmers shall be certified in the Advanced Technical Certification Program.

1.6 CODES AND STANDARDS

- A. It is the responsibility of the Temperature Control Contractor to be familiar with all codes, rules, ordinances, and regulations of the Authority Having Jurisdiction and their interpretations which are in effect at the site of work.
- B. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the installation shall comply with the current editions in effect 30 days prior to the receipt of bids of the following codes:
 - 1. Federal Communications Commission (FCC)

2. Electronics Industries Association (EIA)
 3. American Society of Mechanical Engineers (ASME)
 4. Institute of Electrical and Electronics Engineers (IEEE)
 5. National Electrical Manufacturers Association (NEMA)
 6. National Fire Protection Association (NFPA)
 7. Underwriter's Laboratories (UL)
 8. Occupational Safety and Health Administration (OSHA)
 9. National Electric Code (NEC)
 10. International Building Code (IBC)
 - a. Section 719 Ducts and Air Transfer Openings
 - b. Section 907 Fire Alarm and Detection Systems
 - c. Chapter 28 Mechanical
 11. International Mechanical Code (IMC)
 12. American National Standards Institute (ANSI)
 13. American Society of Heating, Refrigeration and Air Conditioning Engineers
 14. ANSI/ASHRAE Standard 135, BACnet - A Data Communication Protocol for Building Automation and Control Systems
- C. The Temperature Control Contractor shall be solely responsible for compliance with all health and safety regulations, performing the work in a safe and competent manner, and use industry accepted installation procedures required for the work as outlined in this document.
- D. All systems equipment, components, accessories, and installation hardware shall be new and free from defects and shall be UL listed where applicable. All components shall be in current production and shall be a standard product of the system or device manufacturer. Refurbished or reconditioned components are unacceptable. Each component shall bear the make, model number, device tag number (if any), and the UL label as applicable. All System components of a given type shall be the product of the same manufacturer.

1.7 SUBMITTALS

- A. Product Data and Shop Drawings: Meet requirements of Westside Community Schools General Conditions on Shop Drawings, Product Data, and Samples. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawing shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve the Contractor of responsibility to supply sufficient quantities to complete work. Submittals shall include:
1. DDC System Hardware
 - a. A complete bill of materials to be used indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.
 - b. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed below and for relevant items not listed below:
 - 1) Direct digital controllers (controller panels)
 - 2) Transducers and transmitters
 - 3) Sensors (including accuracy data)
 - 4) Actuators
 - 5) Valves
 - 6) Relays and switches
 - 7) Control panels
 - 8) Power supplies

- 9) Batteries
- 10) Operator interface equipment
- 11) Wiring

- c. Wiring diagrams and layouts for each control panel. Show termination numbers.
- d. Schematic diagrams for all field sensors and controllers. Provide floor plans of all sensor locations and control hardware. Riser diagrams showing control network layout, communication protocol, and wire types.

2. Controlled Systems

- a. Riser diagrams showing control network layout, communication protocol, and wire types. System architecture drawing shall identify the exact order in which devices are to be wired for communication, including equipment with packaged controls.
- b. A schematic diagram of each controlled system. The schematics shall have all control points labeled with point names shown or listed. The schematics shall graphically show the location of all control elements in the system. Locations of controllers, JACE, pressure transmitters etc. shall be provided.
- c. A schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.
- d. An instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
- e. A mounting, wiring, and routing plan-view drawing. The design shall take into account HVAC, electrical, and other systems' design and elevation requirements. The drawing shall show the specific location of all concrete pads and bases and any special wall bracing for panels to accommodate this work.
- f. A complete description of the operation of the control system, including sequences of operation. The description shall include and reference a schematic diagram of the controlled system.
- g. A point list for each control system. List I/O points and software points specified in the Sequence of Operation. Indicate alarmed and trended points.

- 3. Quantities of items submitted shall be reviewed but are the responsibility of the Contractor.
- 4. BACnet Protocol Implementation Conformance Statement (PICS) for each submitted type of controller and operator interface.

B. Project Record Documents. Upon completion of installation, submit three copies of record (as- built) documents of the documents shall be submitted for approval prior to final completion and shall include:

- 1. Project Record Drawings. As-built versions of submittal shop drawings provided as PDF files on Solid State media.
- 2. Operation and Maintenance (O&M) Manual.
- 3. As-built versions of submittal product data.
- 4. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
- 5. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing set points and variables.
- 6. Programming manual or set of 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.
- 7. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
- 8. Documentation of programs created using custom programming language including setpoints, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, setpoints, tuning parameters, and objects can be viewed using furnished programming tools.
- 9. Graphic files, programs, and database on magnetic or optical media.
- 10. List of recommended spare parts with part numbers and suppliers.

11. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
 12. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.
 13. Floor plan drawings identifying communication cable pathways through the building, controller locations and concealed sensor locations. Additionally, sensors that are installed in concealed locations shall have a photograph included that shows the location.
 14. Licenses, guarantees, and warranty documents for equipment and systems.
 15. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
- C. Training Materials: Provide course outline and materials for each class before first class. Training shall be furnished via instructor-led sessions, computer-based training, or web-based training.

1.8 WORK BY OTHERS

- A. Automatic Control Valves: Furnished by the Controls Contractor, installed by Mechanical under the supervision of the Temperature Control Contractor. All reducers and fittings necessary to install smaller than pipe size valves shall be furnished and installed under applicable piping sections.
- B. Automatic Control Dampers: Furnished by the Controls Contractor, installed by Mechanical under the supervision of the Temperature Control Contractor. All sheet metal and duct modifications required to support the installation shall be provided by the Mechanical Contractor.
- C. Piping Penetration: Water pressure and differential taps, valve manifolds, flow switches, thermal wells; installed by Mechanical under the supervision of the Temperature Control Contractor.
- D. Power Source Wiring; and all 120 volts A.C. power source wiring: Furnished and installed under Division 26: Electrical:
- E. Westside Community Schools shall contract independently for graphic programming and Front End integration related to this project on the Tridium N4 Supervisor.

1.9 WARRANTY

- A. Warrant work as follows:
 1. At completion of final test of installation and acceptance by the Westside Community Schools, provide any service incidental to proper performance for a period of one year. Provide one year in warranty service with minimum of 2 maintenance/calibration inspections. Unlimited telephone technical support for Westside Community Schools employees shall also be provided during the warranty period. Telephone support shall be available Monday through Friday, 8:00 AM to 5:00 PM.
 2. Warrant labor and materials for specified control system free from defects for a period of 12 months after final acceptance. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.
 3. Exception: Contractor shall not be required to warrant reused devices except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of Engineer's acceptance.

1.10 OWNERSHIP OF PROPRIETARY MATERIAL

- A. Project-specific software and documentation shall become the Owner's property. This includes, but is not limited to:
 - 1. Graphics
 - 2. Record drawings
 - 3. Database
 - 4. Application programming code
 - 5. Documentation
 - 6. BAS software editing tool(s)

PART 2 - PRODUCTS

2.1 GENERAL

- A. The Direct Digital Control System shall consist of the following:
 - 1. Building Controllers – Stand Alone DDC Panels (JACE).
 - 2. Custom Application Controllers
 - 3. Application Specific Controllers.
 - 4. Input/Output Interfaces.
- B. JACE 8000 - Westside Community Schools has standardized on the Niagara N4 platform as the main system software and architecture. All JACES installed must have the same device capacity. Device capacity shall not exceed 250 devices per JACE. When device count becomes 80% of the JACE capacity (200 Devices) additional JACE's are required.
- C. The system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, standalone DDC panels, and operator devices.
- D. System architectural design and programming shall eliminate dependence upon any single device for alarm reporting and control execution. Each DDC shall operate independently by performing its own specified control, alarm management, operator I/O, and historical data collection. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.
 - 1. Application Control Programming shall reside only in the Custom Application Controllers or the Application Specific Controllers. Other than programs and calculations required for Global use, no programming shall reside in the Building Controllers (JACE).
- E. Standalone DDC panels shall be able to access any data from or send control commands and alarm reports directly to any other DDC panel or combination of panels on the network without dependence upon a central processing device, such as a central file server. Standalone DDC panels shall also be able to send alarm reports to multiple operator workstations, terminals, and printers without dependence upon a central processing device or File Server.

2.2 MATERIALS

- A. Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

2.3 NETWORKING/COMMUNICATION

- A. Design of the DDC shall network operator workstations and Standalone DDC Panels as indicated on drawings. Inherent in the system's design shall be the ability to expand or modify the network via a local network.

1. Local Area Network:

- a. Dynamic Data Access: All operator devices shall have the ability to access all point status and application report data or execute control functions for any and all other devices via the local area network.
- b. Access to system data shall not be restricted by the hardware configuration of the DDC. Hardware configuration of the DDC network shall be transparent to user when accessing data or developing control programs.
- c. General Network Design: Network design shall include the following provisions:
 - 1) High speed data transfer rates for alarm reporting, quick report generation from multiple controllers, and upload/download efficiency between network devices.
 - 2) Support of any combination of controllers directly connected to the local area network.
 - 3) Detection and accommodation of single or multiple failures of either DDC panels or the network media. The network shall include provisions for automatically re-configuring itself to allow all operational equipment to perform their designated functions as effectively as possible in the event of single or multiple failures.
 - 4) Message and alarm buffering to prevent information from being lost.
 - 5) Error detection, correction, and re-transmission to guarantee data integrity.
 - 6) Default device definition to prevent loss of alarms or data, and ensure alarms are reported as quickly as possible in the event an operator device does not respond.
 - 7) Commonly available, multiple sourced, networking components shall be used to allow the DDC to coexist with other networking applications. The following are acceptable technologies: BACNET or ETHERNET.
 - 8) Communications must be of a deterministic nature to assure calculable performance under worst case network loading. When a collision-based network is proposed, Contractor shall provide detailed calculations indicating worse-case network response times.
 - 9) Automatic synchronization of the real-time clocks in all DDC panels shall be provided.

B. System Software.

1. Integration and central system graphics shall be provided by an independent third party on the Westside Community Schools-Wide Niagara Tridium N4 Supervisor.
2. The operator interface on the Building Control System Server shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint.
 - a. Functionality. Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.
 - b. Animation. Graphics shall be able to animate by displaying different image files for changed object status.
 - c. Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.
 - d. Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall only require widely available no-cost plug-ins (such as Active-X and Adobe Flash).

- C. System Applications. System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand-alone software programs. If furnished as part of the interface, the tool shall be available from each workstation or web browser interface. If furnished as a stand-alone program, software shall be installable on standard IBM-compatible PCs with no limit on the number of copies that can be installed under the system license.
1. Automatic System Database Configuration. Each workstation or web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.
 2. Manual Controller Memory Download. Operators shall be able to download memory from the system database to each controller.
 3. System Configuration. The workstation software shall provide a method of configuring the system. This shall allow for future system changes or additions by users under proper password protection. Operators shall be able to configure the system.
 4. On-Line Help. Provide a context-sensitive, on-line help system to assist the operator in operating and editing the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.
 5. Security. Each operator shall be required to log on to the system with username and password in order to view, edit, add, or delete data. The Tridium N4 Supervisor and all connected DDC Control Systems shall utilize the Westside Community Schools Active Directory for Single Source Login.
 - a. Operator Access. The username and password combination shall define accessible viewing, editing, adding, and deleting privileges for that operator. Users with system administrator rights shall be able to create new users and edit the privileges of all existing users.
 - b. Automatic Log Out. Automatically log out each operator if no keyboard or mouse activity is detected. This auto logoff time shall be user adjustable.
 - c. Encrypted Security Data. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.
 6. System Diagnostics. The system shall automatically monitor the operation of all building management panels and controllers. The failure of any device shall be annunciated to the operator.
 7. Alarm Processing. System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified in the Sequences of Operation. Alarms shall be BACnet alarm objects and shall use BACnet alarm services.
 8. Alarm Messages. Alarm messages shall use the English language descriptor for the object in alarm in such a way that the operator will be able to recognize the source, location, and nature of the alarm without relying on acronyms.
 9. Alarm Reactions. Operator shall be able to configure (by object) what, if any actions are to be taken during an alarm. As a minimum, the workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send page, and audibly annunciate.
 10. Alarm and Event log. Operators shall be able to view all system alarms and changes of state from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and delete alarms and archive closed alarms to the workstation or web server hard disk.
 11. Trend Logs. The operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. Configure trends as specified in the Sequences of Operation. Trends shall be BACnet trend objects.
 12. Object and Property Status and Control. Provide a method for the operator to view, and edit if applicable, the status of any object or property in the system. The status shall be available by menu, on graphics, or through custom programs.
 13. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.

14. Standard Reports. Furnish the following standard system reports:
- a. Objects. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.
 - b. Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.
 - c. Logs. System shall log the following to a database or text file and shall retain data for an adjustable period:
 - 1) Alarm History.
 - 2) Trend Data. Operator shall be able to select trends to be logged.
 - 3) Operator Activity. At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.
15. Energy Reports. System shall include an easily configured energy reporting tool that provides the capabilities described in this section.
- a. The energy reporting tool shall be accessible through the same user interface (operator workstation software) as is used to manage the BAS.
 - b. The energy reporting tool shall be preconfigured by the Contractor to gather and store energy demand and consumption data from each energy source that provides metered data to the BAS. Analog meter data shall be stored at 5 minute intervals unless otherwise specified in the Sequence of Operation. Binary or multiple-state meter data shall be stored at change of value (CoV) rate unless otherwise specified in the Sequence of Operation. This data shall be maintained in an industry standard SQL database for a period of not less than five years.
 - c. The energy reporting tool shall allow the operator to select an energy source and a time period of interest (day, week, month, year, or date range) and shall provide options to view the data in a table, line graph, bar graph, or pie chart. The tool shall also allow the operator to select two or more data sources and display a comparison of the energy used over this period in any of the listed graph formats, or to total the energy used by the selected sources and display that data in the supported formats.
 - d. The energy reporting tool shall allow the operator to select an energy source and two time periods of interest (day, week, month, year, or date range) and display a graph that compares the energy use over the two time periods in any of the graph formats listed in the previous paragraph. The tool shall also allow the operator to select multiple energy sources and display a graph that compares the total energy used by these sources over the two time periods.
 - e. The energy reporting tool shall allow the operator to easily generate the previously described graphs "on the fly," and shall provide an option to store the report format so the operator can select that format to regenerate the graph at a future date. The tool shall also allow the user to schedule these reports to run on a recurring basis using relative time periods, such as automatically generating a consumption report on the first Monday of each month showing consumption over the previous month. Automatically generated reports shall be archived on the server in a common industry format such as Adobe PDF or Microsoft Excel with copies e-mailed to a user editable list of recipients.
 - f. The energy reporting tool shall be capable of collecting and displaying data from the following types of meters:
 - 1) Gas
 - 2) Potable Water
 - 3) Electricity
 - 4) Hydronic Flow
 - 5) Steam
 - g. The user shall have the option of using Btu/hr (Btu) as the units for demand and consumption reports. Multiples of these units (MWH, kBtu, etc.) shall be used as appropriate. All selected sources shall be automatically converted to the selected units. The user shall similarly have the option of entering facility

- area and occupancy hours and creating reports that are normalized on an area basis, an annual use basis, or an occupied hour basis.
 - h. The user shall have the option of entering benchmark data for an individual facility or a group of facilities.
 - i. The user shall have the option of displaying any or all of the following data on any chart, line, or bar graph generated by the energy reporting tool:
 - 1) Low/High/Average value of the metered value being displayed.
 - 2) Heating and/or Cooling Degree Days for the time period(s) being displayed.
 - j. The Owner may implement this tool at some point in the future. All features and software capabilities described above shall be provided with this installation.
- D. Workstation Application Editors. Each PC or browser workstation shall support editing of all system applications via password protected web access. The applications shall be downloaded and executed at one or more of the controller panels.
 - 1. Controller. Provide a full-screen editor for each type of application that shall allow the operator to view and change the configuration, name, control parameters, and set points for all controllers.
 - 2. Scheduling. An editor for the scheduling application shall be provided at each workstation. Provide a method of selecting the desired schedule and schedule type. Exception schedules and holidays shall be shown clearly on the calendar. The start and stop times for each object shall be adjustable from this interface. All schedules shall be BACnet schedule objects.
 - 3. Custom Application Programming. Provide the tools to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded. Programming language shall have the following features:
 - a. Language. Language shall be graphically based or English language oriented. If graphically based, language shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks. Any ancillary software required to support function block programming shall be supplied with the control system. If English language oriented, language shall be based on the syntax of BASIC, FORTRAN, C, or PASCAL, and shall allow for free-form programming that is not column- oriented or "fill-in-the-blanks."
 - b. A full-screen character editor programming environment shall be provided. The editor shall be cursor/mouse-driven and allow the user to insert, add, modify, and delete custom programming code. It also shall incorporate features such as cut/ paste and find.
 - c. The programming language shall allow independently executing program modules to be developed. Each module shall be able to independently enable and disable other modules.
 - d. The editor/programming environment shall have a debugging/simulation capability that allows the user to step through the program and observe any intermediate values and/or results.
 - e. The programming language shall support conditional statements (IF/THEN/ELSE/ ELSE-IF) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
 - f. The programming language shall support floating-point arithmetic using the following operators: +, -, ÷, ×, and square root. The following mathematical functions also shall be provided: absolute value and minimum/maximum value.
 - g. The programming language shall have predefined variables that represent time of day, day of the week, month of the year, and the date. Other predefined variables shall provide elapsed time in seconds, minutes, hours, and days. These elapsed time variables shall be able to be reset by the language so that interval-timing functions can be stopped and started within a program. Values from all of the above variables shall be readable by the language so that they can be used in a program for such purposes as IF/ THEN comparisons, calculations, etc.
 - h. The language shall be able to read the values of the variables and use them in programming statement logic, comparisons, and calculations.

- i. The programming language shall have predefined variables representing the status and results of the system software and shall be able to enable, disable, and change the setpoints of the system software.

2.4 CONTROLLER SOFTWARE

- A. Furnish the following applications for building and energy management. All software applications shall reside and operate in the system controllers. Applications shall be editable through operator workstation, web browser interface, or engineering workstation.
- B. The Westside Community Schools District shall provide a Laptop on which the Contractor shall install all controller service software. The controller service software shall allow the technician to manually control all output points, read values of all input points and virtual points for all provided controllers. The Service software shall allow Westside Community Schools to edit, develop new or delete any custom programming. All required cabling and adapters shall be provided for the Laptop to interface to all provided field controllers. The Controls Contractor shall provide all software and adapters required at the time of Substantial Completion of this project. Any passwords or hardware keys shall be provided with the software at Substantial completion. Providing this software shall not void any warranty coverage for the installation of the Control Systems.
- C. System Security. See Paragraph 2.3.C.5 (Security) and Paragraph 2.3.E.14.c. 3) (Operator Activity).
- D. Scheduling. Provide the capability to execute control functions according to a user created or edited schedule. Each schedule shall provide the following schedule options as a minimum:
 - 1. Weekly Schedule. Provide separate schedules for each day of the week. Each schedule shall be able to include up to 5 occupied periods (5 start-stop pairs or 10 events). Initial schedules shall provide for Optimal start of the equipment 2 hours before occupancy. Start time is 7:40 and stop time is 5:00.
 - 2. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. Exception schedules may be defined up to a year in advance. Once an exception schedule has executed, the system shall discard and replace the exception schedule with the standard schedule for that day of the week.
 - 3. Holiday Schedules. Provide the capability for the operator to define up to 24 special or holiday schedules. These schedules will be repeated each year. The operator shall be able to define the length of each holiday period.
 - 4. All schedules shall be BACnet schedule objects.
- E. System Coordination. Operator shall be able to group related equipment based on function and location and to use these groups for scheduling and other applications.
- F. Binary Alarms. Each binary object shall have the capability to be configured to alarm based on the operator-specified state. Provide the capability to automatically, and manually, disable alarming.
- G. Analog Alarms. Each analog object shall have both high and low alarm limits. The operator shall be able to enable or disable these alarms.
- H. Alarm Reporting. The operator shall be able to determine the action to be taken in the event of an alarm. An alarm shall be able to start programs, print, be logged in the event log, generate custom messages, and display on graphics.
- I. Remote Communication. System shall automatically contact operator workstation or server on receipt of critical alarms.
- J. Demand Limiting.

1. The demand-limiting program shall monitor building power consumption from a building power meter (provided by others) which generates pulse signals or a BACnet communications interface. An acceptable alternative is for the system to monitor a watt transducer or current transformer attached to the building feeder lines.
 2. When power consumption exceeds adjustable levels, system shall automatically adjust setpoints, de-energize low-priority equipment, and take other programmatic actions to reduce demand as specified in the Sequence of Operation. When demand drops below adjustable levels, system shall restore loads as specified.
- K. Maintenance Management. The system shall be capable of generating maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits. Configure and enable maintenance alarms as specified in the Sequence of Operation.
- L. Sequencing. Application software shall sequence chillers, boilers, and pumps as specified in the Sequence of Operation.
- M. PID Control. System shall provide direct- and reverse-acting PID (proportional-integral- derivative) algorithms. Each algorithm shall have anti-windup and selectable controlled variable, setpoint, and PID gains. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs. The calculation interval, PID gains, and other tuning parameters shall be adjustable by a user with the correct security level.
2. PID Loop outputs shall be programmed to match the operating range of the device being controlled such that 0% = Closed or Off, and 100% = Open or Full Design Operating Speed.
- N. Staggered Start. System shall startup by time schedules and restart after power outage. All HVAC contained within an area or zone shall stagger the startup of the equipment. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.
- O. Energy Calculations.
1. The system shall accumulate and convert instantaneous power (kW) or flow rates (gpm) to energy usage data.
 2. The system shall calculate a sliding-window average (rolling average). Operator shall be able to adjust window interval to 15 minutes, 30 minutes, or 60 minutes.
- P. Anti-Short Cycling. All binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.
- Q. On and Off Control with Differential. Provide an algorithm that allows a binary output to be cycled based on a controlled variable and a setpoint. The algorithm shall be direct-acting or reverse-acting.
- R. Runtime Totalization. Provide software to totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit. Configure and enable runtime totalization and alarms as specified in the Sequence of Operation.
- 2.5 CONTROLLERS
- A. General. Provide an adequate number of JACE Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance specified. Every device in the system which executes control logic and directly controls HVAC equipment must conform to a standard BACnet Device profile as specified in ANSI/ASHRAE 135, BACnet Annex L. Unless otherwise specified, hardwired actuators and sensors may be used in lieu of BACnet Smart Actuators and Smart Sensors. Building controllers shall be JACE8000.
- B. BACnet.

1. Building Controllers (BCs). Each BC shall conform to BACnet Building Controller (B-BC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L, and shall be listed as a certified B-BC in the BACnet Testing Laboratories (BTL) Product Listing.
2. Advanced Application Controllers (AACs). Each AAC shall conform to BACnet Advanced Application Controller (B-AAC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-AAC in the BACnet Testing Laboratories (BTL) Product Listing.
3. Application Specific Controllers (ASCs). Each ASC shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.
4. Smart Sensors (SSs). Each SS shall conform to BACnet Smart Sensor (B-SS) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-SS in the BACnet Testing Laboratories (BTL) Product Listing.
5. Packaged Controllers (OEM). Each packaged controller shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.
6. BACnet Communication.
 - a. Each BC JACE shall reside on or be connected to a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing. The BC JACE shall be the only device(s) that CCSD shall allow to reside on the CCSD network. All other BAS devices shall reside on an internal network created by the contractor.
 - b. BACnet routing shall be performed by BCs or other BACnet device routers as necessary to connect BCs to networks of AACs and ASCs.
 - c. Each AAC shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
 - d. Each ASC shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
 - e. Each SA shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
 - f. Each SS shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using ARCNET or MS/TP Data Link/Physical layer protocol.

C. Communication

1. Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.
2. Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.
3. Data Sharing. Each BC and AAC shall share data as required with each networked BC and AAC.
4. Stand-Alone Operation. Each piece of equipment specified shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network such as outdoor air conditions, supply air or water temperature coming from source equipment, etc.

D. Environment. Controller hardware shall be suitable for anticipated ambient conditions.

1. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -29°C to 60°C (-20°F to 140°F).
2. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).

E. Keypad. Provide software and any interface cabling needed to use a laptop computer as a Portable Operator's Terminal for the Controllers.

- F. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.
- G. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to a field-removable modular terminal strip or to a termination card connected by a ribbon cable. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.
- H. Memory.
 - 1. Controller memory shall support operating system, database, and programming requirements.
 - 2. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.
 - 3. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.
- I. Immunity to Power and Noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).
- J. Transformer. ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.

2.6 INPUT AND OUTPUT INTERFACE

- A. General. Hard-wire input and output points to BCs, AACs, ASCs, or SAs.
- B. Protection. All input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground shall cause no damage to the controller. All input and output points shall be protected from voltage up to 24 V of any duration, such that contact with this voltage will cause no controller damage.
- C. Space Setpoints. Space setpoints will be controllable from the space thermostat or from the BAS system. Operator will have the ability to choose if the setpoint used comes from the thermostat or BAS. On new installations the default shall be -Thermostat adjustments disabled, and BAS enabled. Occupied Setpoints, both BAS and Local shall be limited to the following:
 - 1. Cooling High Limit = 76
 - 2. Cooling low limit = 70
 - 3. Heating High Limit = 74
 - 4. Heating low limit = 68

Note: Refer to the most recent version of the Westside Community Schools Integration Guidelines to confirm these values at the time of programming.

- D. Binary Inputs. Binary inputs shall allow the monitoring of ON/OFF signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.
- E. Pulse Accumulation Inputs. Pulse accumulation inputs shall conform to binary input requirements and shall also accumulate up to 10 pulses per second.
- F. Analog Inputs. Analog inputs shall monitor low-voltage (0–10 Vdc), current (4–20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.

- G. Binary Outputs. Binary outputs shall provide for ON/OFF operation or a pulsed low-voltage signal for pulse width modulation control. Binary outputs on AACs and ASCs shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.
- H. Analog Outputs. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0–10 Vdc, 2–10 Vdc or a 4–20 mA signal as required to properly control output devices. Analog outputs shall not drift more than 0.4% of range annually.
- I. Tri-State Outputs. Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.
- J. System Object Capacity. The system size shall be expandable to at least twice the number of input/ output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The operator interfaces installed for this project shall not require any hardware additions or software revisions in order to expand the system.

2.7 POWER SUPPLIES AND LINE FILTERING

- A. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
 - 1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.
 - a. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
 - b. Line voltage units shall be UL recognized and CSA listed.
- B. Power Line Filtering.
 - 1. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:
 - a. Dielectric strength of 1000 V minimum
 - b. Response time of 10 nanoseconds or less
 - c. Transverse mode noise attenuation of 65 dB or greater
 - d. Common mode noise attenuation of 150 dB or greater at 40–100 Hz

2.8 AUXILIARY CONTROL DEVICES

- A. Motorized Control Dampers, unless otherwise specified elsewhere, shall be as follow:
 - 1. Type. Control dampers shall be the parallel or opposed-blade type as specified below or as scheduled on drawings.
 - a. Outdoor and return air mixing dampers and face-and-bypass dampers shall be parallel-blade and shall direct airstreams toward each other.
 - b. Other modulating dampers shall be opposed-blade.

- c. Two-position shutoff dampers shall be parallel- or opposed-blade with blade and side seals.
2. Frame. Damper frames shall be 2.38 mm (13 gauge) galvanized steel channel or 3.175 mm (1/8 in.) extruded aluminum with reinforced corner bracing.
 3. Blades. Damper blades shall not exceed 20 cm (8 in.) in width or 125 cm (48 in.) in length. Blades shall be suitable for medium velocity (10 m/s [2000 fpm]) performance. Blades shall be not less than 1.5875 mm (16 gauge).
 4. Shaft Bearings. Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze, or better.
 5. Seals. Blade edges and frame top and bottom shall have replaceable seals of butyl rubber or neoprene. Side seals shall be spring-loaded stainless steel. Blade seals shall leak no more than 50 L/s·m² (10 cfm per ft²) at 1000 Pa (4 in. w.g.) differential pressure. Blades shall be airfoil type suitable for wide-open face velocity of 7.5 m/s (1500 fpm).
 6. Sections. Individual damper sections shall not exceed 125 cm × 150 cm (48 in. × 60 in.). Each section shall have at least one damper actuator.
 7. Modulating dampers shall provide a linear flow characteristic where possible.
 8. Linkages. Dampers shall have exposed linkages.
- B. Electric Damper and Valve Actuators.
1. Stall Protection. Mechanical or electronic stall protection shall prevent actuator damage throughout the actuator's rotation.
 2. Spring-return Mechanism. Actuators used for power-failure and safety applications shall have an internal mechanical spring-return mechanism or an uninterruptible power supply (UPS).
 3. Signal and Range. Proportional actuators shall accept a 0–10 Vdc or a 0–20 mA control signal and shall have a 2–10 Vdc or 4–20 mA operating range. (Floating motor actuators may be substituted for proportional actuators in terminal unit applications as described in paragraph 2.6H.)
 4. Wiring. 24 Vac and 24 Vdc actuators shall operate on Class 2 wiring.
 5. Manual Positioning. Operators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 7 N·m (60 in.-lb) torque capacity shall have a manual crank.
 6. All Damper and Valve Actuators shall be by Belimo or approved substitute.
- C. Control Valves.
1. Control valves shall be two-way or three-way type for two-position or modulating service as shown.
 2. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
 - a. Water Valves:
 - 1) Two-way: 150% of total system (pump) head.
 - 2) Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
 3. Water Valves.
 - a. Body and trim style and materials shall be in accordance with manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.
 - b. Sizing Criteria:
 - 1) Two-position service: Line size.
 - 2) Two-way modulating service: Valve CV shall be calculated based on design parameters and resulting calculation provided with the valve submittal. Pressure drop across the control valve shall not exceed 3 PSI.

- 3) Three-way modulating service: Valve CV shall be calculated based on design parameters and resulting calculation provided with the valve submittal. Pressure drop across the control valve shall not exceed 3 PSI
- 4) Valves ½ in. through 2 in. shall be bronze body or cast brass ANSI Class 250, spring-loaded, PTFE packing, quick opening for two- position service. Two-way valves to have replaceable composition disc or stainless steel ball.
- 5) Valves 2½ in. and larger shall be cast iron ANSI Class 125 with guided plug and PTFE packing.

c. Water valves shall fail normally open or closed, as scheduled on plans, or as follows:

- 1) Water zone valves—normally open preferred.
- 2) Heating coils in air handlers—normally open.
- 3) Chilled water control valves—normally closed.
- 4) Other applications—as scheduled or as required by sequences of operation.

D. Binary Temperature Devices.

1. Low-Voltage Space Thermostats. Low-voltage space thermostats shall be 24 V, bimetal-operated, micro-switch type, with adjustable or fixed anticipation heater, concealed setpoint adjustment, (55°F–85°F) setpoint range, (2°F) maximum differential, and vented ABS plastic cover.
2. Line-Voltage Space Thermostats. Line-voltage space thermostats shall be bimetal- actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, (55°F–85°F) setpoint range, (2°F) maximum differential, and vented ABS plastic cover.
3. Low-Limit Thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least (20 ft) long. Element shall sense temperature in each (1 ft) section and shall respond to lowest sensed temperature. Provide a minimum of (5 ft) of element length per (10 ft²) of coil cross-section. Low-limit thermostat shall be manual reset only. Electronic latching circuits shall not be permitted to substitute for a manual reset device. Low-limit thermostat shall incorporate dual switches for both Low and Line voltage switching simultaneously.

E. Temperature Sensors.

1. Type. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.
2. Duct Sensors. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of (5 ft) in length per (10 ft²) of duct cross- section.
3. Immersion Sensors. Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.
4. Space Sensors. Space sensors shall have an adjustable setpoint adjustment and include space temperature and space humidity. The space adjustment shall be disabled with control of the setpoint through the BAS.
5. Differential Sensors. Provide matched sensors for differential temperature measurement.
6. Temperature sensors shall not drift more than +/- .5 Deg-F annually.

F. Humidity Sensors.

1. Duct and room sensors shall have a sensing range of 0%–100%.
2. Duct sensors shall have a sampling chamber.
3. Outdoor air humidity sensors shall have a sensing range of 0%–100% RH and shall be suitable for ambient conditions of (-40°F–+170°F).
4. Humidity sensors shall not drift more than 2% of full scale annually.

G. CO2 Sensors, Duct and Wall.

1. General: Provide non-dispersive infrared (NDIR), diffusion sampling CO2 sensors with integral transducers and linear output.
2. Air Temperature: Range of 32 to 122 degrees F.

3. Relative Humidity: Range of 0 to 95 percent (non-condensing).
 4. Power Input: Class 2; 12 to 30VDC or 24VAC 50/60 Hz; 100mA max.
 5. Calibration Characteristics:
 - a. Range: 0 – 2000 ppm.
 - b. Automatically compensating algorithm for sensor drift due to sensor degradation.
 - c. Maximum Drift: 2 percent.
 - d. User calibratable with a minimum calibration interval of 5 years.
 6. Construction:
 - a. Sensor Chamber: Non-corrosive material for neutral effect on carbon dioxide sample.
 - b. Provide duct mounted sensors with duct probe designed to protect sensing element from dust accumulation and mechanical damage.
 - c. Housing: High impact plastic.
- H. Flow Switches. Flow-proving switches shall be paddle (water service only) or differential pressure type (air or water service) as shown. Switches shall be UL listed, SPDT snap- acting, and pilot duty rated (125 VA minimum).
1. Paddle switches shall have adjustable sensitivity and NEMA 1 enclosure unless otherwise specified.
 2. Differential pressure switches shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.
- I. Current Sensing Switches shall be selected with a range to match the device current being measured. Sensors shall be adjusted so that the switch provides an “On” indication only if the pump or fan is under load and actually moving media.
1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system input requirements.
 2. Current Sensing Switches shall not be used on the load output of a VFD. VFD status shall be taken from the Drive directly.
 3. Status indicating devices for ECM motors shall be capable of reliably detecting the lowest speed of the device that is allowable by the manufacturer.
- J. Relays.
1. Control Relays. Control relays shall be plug-in type, UL listed, and shall have dust cover and LED “energized” indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
 2. Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable $\pm 100\%$ from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.
- K. Override Timers.
1. Unless implemented in control software, override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration required by application. Provide 0–6 hour calibrated dial unless otherwise specified. Flush mount timer on local control panel face or where shown.
- L. Current Transmitters.
1. AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4–20 mA two-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be $\pm 1\%$ full-scale at 500 ohm maximum burden.

2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.
3. Unit shall be split-core type for clamp-on installation on existing wiring.

M. Current Transformers.

1. AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.
2. Transformers shall be available in various current ratios and shall be selected for $\pm 1\%$ accuracy at 5 A full-scale output.
3. Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.

N. Voltage Transmitters.

1. AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4–20 mA output with zero and span adjustment.
2. Adjustable full-scale unit ranges shall be 100–130 Vac, 200–250 Vac, 250–330 Vac, and 400–600 Vac. Unit accuracy shall be $\pm 1\%$ full-scale at 500 ohm maximum burden.
3. Transmitters shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized at 600 Vac rating.

O. Voltage Transformers.

1. AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.
2. Transformers shall be suitable for ambient temperatures of 4°C–55°C (40°F–130°F) and shall provide $\pm 0.5\%$ accuracy at 24 Vac and 5 VA load.
3. Windings (except for terminals) shall be completely enclosed with metal or plastic.

P. Power Monitors.

1. Selectable rate pulse output for kWh reading, 4–20 mA output for kW reading, N.O. alarm contact, and ability to operate with 5.0 amp current inputs or 0–0.33 volt inputs.
2. 1.0% full-scale true RMS power accuracy, +0.5 Hz, voltage input range 120–600 V, and auto range select.
3. Under voltage/phase monitor circuitry.
4. NEMA 1 enclosure.
5. Current transformers having a 0.5% FS accuracy, 600 VAC isolation voltage with 0–0.33 V output. If 0–5 A current transformers are provided, a three-phase disconnect/shorting switch assembly is required.

Q. Hydronic Flowmeters

1. Insertion-Type Turbine Meter

- a. Dual counter-rotating axial turbine elements, each with its own rotational sensing system, and an averaging circuit to reduce measurement errors due to swirl and flow profile distortion. Single turbine for piping 2 inches and smaller. Flow sensing turbine rotors shall be non-metallic and not impaired by magnetic drag.
- b. Insertion type complete with 'hot-tap' isolation valves to enable sensor removal without water supply system shutdown.
- c. Sensing method shall be impedance sensing (nonmagnetic and non-photoelectric)
- d. Volumetric accuracy
 - 1) $\pm 0.5\%$ of reading at calibrated velocity
 - 2) $\pm 1\%$ of reading from 3 to 30 ft/s (10:1 range)
 - 3) $\pm 2\%$ of reading from 0.4 to 20 ft/s (50:1 range)

- e. Each sensor shall be individually calibrated and tagged accordingly against the manufacturer's primary standards which must be accurate to within 0.1% of flow rate and traceable to the National Institute of Standards and Technology (NIST).
- f. Maximum operating pressure of 400 psi and maximum operating temperature of 200°F continuous (220°F peak).
- g. All wetted metal parts shall be constructed of 316 stainless steel.
- h. Analog outputs shall consist of non-interactive zero and span adjustments, a DC linearity of 0.1% of span, voltage output of 0-10 Vdc, and current output of 4-20 mA.

2. Magnetic Flow-Tube Type Flowmeter

- a. Sensor shall be a magnetic flowmeter, which utilizes Faraday's Law to measure volumetric fluid flow through a pipe. The flowmeter shall consist of two elements, the sensor and the electronics. The sensor shall generate a measuring signal proportional to the flow velocity in the pipe. The electronics shall convert this EMF into a standard current output.
- b. Electronic replacement shall not affect meter accuracy (electronic units are not matched with specific sensors).
- c. Four-wire, externally powered, magnetic type flow transmitter with adjustable span and zero, integrally mounted to flow tube. Output signal shall be a digital pulse proportional to the flow rate (to provide maximum accuracy and to handle abrupt changes in flow). Standard 4-20 mA or 0-10 Vdc outputs may be used provided accuracy is as specified.
- d. Flow Tube:
 - 1) ANSI class 150 psig steel
 - 2) ANSI flanges
 - 3) Protected with PTFE, PFA, or ETFE liner rated for 245°F minimum fluid temperature
- e. Electrode and grounding material
 - 1) 316L Stainless steel or Hastelloy C
 - 2) Electrodes shall be fused to ceramic liner and not require o-rings.
- f. Electrical Enclosure: NEMA 4, 7
- g. Approvals:
 - 1) UL or CSA
 - 2) NSF Drinking Water approval for domestic water applications
- h. Performance
 - 1) Accuracy shall be $\pm 0.5\%$ of actual reading from 3 to 30 ft/s flow velocities, and 0.015 ft/s from 0.04 to 3 ft/s.
 - 2) Stability: 0.1% of rate over six months.
 - 3) Meter repeatability shall be $\pm 0.1\%$ of rate at velocities > 3 ft/s.

3. Magnetic Insertion-Type Flowmeter

- a. Magnetic Faraday point velocity measuring device.
- b. Insertion type complete with hot-tap isolation valves to enable sensor removal without water supply system shutdown.
- c. 4-20 mA transmitter proportional to flow or velocity.
- d. Accuracy: larger of 1% of reading and 0.2 ft/s.
- e. Flow range: 0.2 to 20 ft/s, bidirectional.

- f. Each sensor shall be individually calibrated and tagged accordingly against the manufacturer's primary standards which must be accurate to within 0.1% of flow rate and traceable to the National Institute of Standards and Technology (NIST).
4. Vortex Shedding Flowmeter
 - a. Output: 4-20 mA, 0-10 Vdc, 0-5 Vdc.
 - b. Maximum Fluid Temperature: 800°F (427 °C).
 - c. Wetted Parts: Stainless Steel.
 - d. Housing: NEMA 4X.
 - e. Turndown: 25:1 minimum.
 - f. Accuracy: 0.5% of calibrated span for liquids, 1% of calibrated span for steam and gases.
 - g. Body: Wafer style or ANSI flanged to match piping specification.
5. Transit-Time Ultrasonic Flowmeter
 - a. Clamp-On transit-time ultrasonic flowmeter
 - b. Wide-Beam transducer technology
 - c. 4-20 mA transmitter proportional to flow or velocity.
 - d. Accuracy: 0.5% of reading in range 1 to 30 ft/s, 0.001 ft/s sensitivity.
- R. Thermal Energy Meters
 1. Matched RTD, solid state, or thermistor temperature sensors with a differential temperature accuracy of $\pm 0.15^{\circ}\text{F}$.
 2. Flow meter: See "Hydronic Flowmeters" section.
 3. Unit accuracy of $\pm 1\%$ factory calibrated, traceable to NIST with certification.
 4. NEMA 1 enclosure.
 5. Panel mounted display.
 6. UL listed.
 7. Isolated 4–20 ma signals for energy rate and supply and return temperatures and flow.
- S. Pressure Transducers.
 1. Transducers shall have linear output signal and field-adjustable zero and span.
 2. Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.
 3. Water pressure transducer diaphragm shall be stainless steel with minimum proof pressure of (150 psi). Transducer shall have 0-10 Volt or 4–20 mA output, suitable mounting provisions, and block and bleed valves.
 4. Water differential pressure transducer diaphragm shall be stainless steel with minimum proof pressure of (150 psi). Over-range limit (differential pressure) and maximum static pressure shall be (300 psi.). Transducer shall have 0-10 Volt or 4–20 mA output, suitable mounting provisions, and 5-valve manifold.
 5. Analog output shall not drift more than +/- 1% annually.
- T. Differential Pressure Switches. Differential pressure switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified. Differential pressure switches designated for High Limit functions shall be provided with Manual Reset if specified.
- U. Pressure-Electric (PE) Switches.
 1. Shall be metal or neoprene diaphragm actuated, operating pressure rated for (0–25 psig), with calibrated scale minimum setpoint range of (2–18 psig) minimum, UL listed.
 2. Provide one or two-stage switch action (SPDT, DPST, or DPDT) as required by application Electrically rated for pilot duty service (125 VA minimum) and/or for motor control.

3. Switches shall be open type (panel-mounted) or enclosed type for remote installation. Enclosed type shall be NEMA 1 unless otherwise specified.
 4. Each pneumatic signal line to PE switches shall have permanent indicating gauge.
- V. Occupancy Sensors. Occupancy sensors shall utilize Passive Infrared (PIR) and/or Microphonic Passive technology to detect the presence of people within a room. Sensors shall be mounted as indicated on the approved drawings. The sensor output shall be accessible by any lighting and/or HVAC controller in the system. Occupancy sensors shall be capable of being powered from the lighting or HVAC control panel, as shown on the drawings. Occupancy sensor delay shall be software adjustable through the user interface and shall not require manual adjustment at the sensor.
- W. Local Control Panels.
1. All indoor control cabinets shall be fully enclosed NEMA 1 construction with (hinged door) key-lock latch and removable subpanels. A single key shall be common to all field panels and subpanels.
 2. Interconnections between internal and face-mounted devices shall be prewired with color-coded stranded conductors neatly installed in plastic troughs and/or tie- wrapped. Terminals for field connections shall be UL listed for 600 volt service, individually identified per control/ interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
 3. Provide ON/OFF power switch with overcurrent protection for control power sources to each local panel.

2.9 WIRING AND RACEWAYS

- A. General. Provide copper wiring, plenum cable, and raceways as specified in applicable sections of Division 26.
- B. Insulated wire shall use copper conductors and shall be UL listed for 90°C (200°F) minimum service.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. 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 rough-in work is started.
- B. 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 and the plans and the 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 at the expense of—this contractor.

3.2 PROTECTION

- A. The contractor shall protect all work and material from damage by his/her work or employees and shall be liable for all damage thus caused.
- B. 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.

3.3 COORDINATION

A. Site

1. 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 without extra charge.
2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.

B. Submittals. See Specifications for submittal requirements.

C. Test and Balance.

1. The contractor shall furnish a single set of all tools necessary to interface to the control system 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 coordinate and assist in the test and balance process as needed.
4. The tools used during the test and balance process will be returned at the completion of the testing and balancing.

D. Life Safety.

1. Duct smoke detectors required for air handler shutdown are provided under Division 28. Interlock smoke detectors to air handlers for shutdown as specified in the Sequence of Operation.
2. Smoke dampers and actuators required for duct smoke isolation are provided under Division 23. Interlock smoke dampers to air handlers as specified in the Sequence of Operation.
3. Fire and smoke dampers and actuators required for fire-rated walls are provided under Division 23. Fire and smoke damper control is provided under Division 28.

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 control system specified in this section. These controls shall be integrated into the system and coordinated by the contractor as follows:

1. All communication media and equipment shall be provided as specified.
2. Each supplier of a controls product is responsible for the configuration, programming, start up, and testing of that product to meet the sequences of operation.
3. The contractor shall coordinate and resolve any incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.
4. The 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.

3.4 GENERAL WORKMANSHIP

- A. Install equipment, piping, and wiring/raceway parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.
- B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

- C. Install equipment in readily accessible locations as defined by Chapter 1 Article 100 Part A of the National Electrical Code (NEC).
- D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- E. All equipment, installation, and wiring shall comply with industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.5 FIELD QUALITY CONTROL

- A. All work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances.
- B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship.
- C. Contractor shall have work inspection by local and/or state authorities having jurisdiction over the work.

3.6 EXISTING EQUIPMENT

- A. Wiring. Interconnecting control wiring shall be removed and shall become the property of the contractor unless specifically noted or shown to be reused.
- B. Local Control Panels. Remove and deliver existing control panels to Owner.
- C. Repair. Unless otherwise directed, the contractor is not responsible for repair or replacement of existing energy equipment and systems, valves, dampers, or actuators. Should the contractor find existing equipment that requires maintenance, the engineer is to be notified immediately.
- D. Indicator Gauges. Where these devices remain and are not removed, they must be made operational and recalibrated to ensure reasonable accuracy.
- E. Room Thermostats. Remove and deliver existing room thermostats to Owner unless otherwise noted. Patch and finish holes and marks left by removal to match existing walls.
- F. Electronic Sensors and Transmitters. Remove and deliver existing sensors and transmitters to Owner.
- G. Controllers and Auxiliary Electronic Devices. Remove and deliver existing controllers and auxiliary electronic devices to Owner.
- H. Damper Actuators, Linkages, and Appurtenances. Remove and deliver existing damper actuators, linkages and appurtenances to Owner.
- I. Control Valves. Replace existing control valves with new. Deliver removed control valves to Owner.
- J. Control Compressed Air Systems. Replace existing control compressed air systems with new unless otherwise noted. Deliver removed systems to Owner.
- K. Existing System Operating Schedule. Existing mechanical system may be disabled during this work.
- L. The scheduling of fans through existing or temporary time clocks or control system shall be maintained throughout the DDC system installation
- M. Install control panels where shown.

- N. Modify existing starter control circuits, if necessary, to provide hand-off-auto control of each controlled starter. If new starters or starter control packages are required, these shall be included as part of this contract.
- O. Patch holes and finish to match existing walls.

3.7 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.
- B. All NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway according to NEC and Division 26 requirements.
- C. All 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.
- D. 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.
- E. All wiring in mechanical, electrical, or service rooms – or where subject to mechanical damage – shall be installed in raceway.
- F. 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).
- G. Do not install wiring in raceway containing tubing.
- H. Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or perpendicular to it and supported per the requirements of the NEC.
- I. 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.
- J. 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.
- K. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- L. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the contractor shall provide step-down transformers.
- M. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.
- N. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.
- O. 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.
- P. Include one pull string in each raceway 1 in. or larger.
- Q. Use color-coded conductors throughout with conductors of different colors.

- R. 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.
- S. Conceal all raceways except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 6 in. from high-temperature equipment (e.g. steam pipes or flues).
- T. 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.
- U. Adhere to this specification's Division 26 requirement where raceway crosses building expansion joints.
- V. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of vertical raceways.
- W. 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.
- X. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 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.
- Y. 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.

3.8 COMMUNICATION WIRING

- A. The contractor shall adhere to the items listed in the "Wiring" article in Part 3 of the specification.
- B. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling
- C. Do not install communication wiring in raceways and enclosures containing Class 1 or other Class 2 wiring.
- D. Maximum pulling, tension, and bend radius for the cable installation, as specified by the cable manufacturer, shall not be exceeded during installation.
- E. Contractor shall verify the integrity of the entire network following cable installation. Use appropriate test measures for each particular cable.
- F. 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.
- G. All runs of communication wiring shall be un-spliced length when that length is commercially available.
- H. All communication wiring shall be labeled to indicate origination and destination data.
- I. All communication wiring pathways shall be documented on the Controls As-Built drawings.
- J. Grounding of coaxial cable shall be in accordance with NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."
- K. 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 30 pF per foot.
2. The maximum length of an MS/TP segment is 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 using repeaters.
4. An MS/TP EIA-485 network shall have no T connections.

3.9 INSTALLATION OF SENSORS

- A. Install sensors in accordance with the manufacturer's recommendations.
- B. Mount sensors rigidly and adequately for environment within which the sensor operates.
- C. Room temperature sensors shall be installed on concealed junction boxes properly supported by wall framing.
- D. All wires attached to sensors shall be sealed in their raceways or in the wall to stop air transmitted from other areas from affecting sensor readings.
- E. Sensors used in mixing plenums shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip. Provide a minimum of 1 ft. of sensing element for each 2 ft² of coil area.
- F. Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide a minimum of 1 ft. of sensing element for each 2 ft² of coil area.
- G. Do not install temperature sensors within the vapor plume of a humidifier. If installing a sensor downstream of a humidifier, install it at least 10 ft. downstream.
- H. All pipe-mounted temperature sensors shall be installed in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells. Surface Mounted Sensors shall not be permitted.
- I. Install outdoor air temperature sensors on north wall, complete with sun shield at designated location.
- J. Differential Air Static Pressure.
 1. Supply Duct Static Pressure. Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the high-pressure tap tubing of the corresponding building static pressure sensor (if present). If a building static pressure sensor is not present, pipe the low-pressure port to the location of the duct high-pressure tap and leave open to the plenum.
 2. Return Fan Discharge Static Pressure.
 3. Systems with Relief Air to the Outside: Pipe high-pressure tap to the discharge plenum using a pitot tube. Pipe the low-pressure port to an Outside static pressure sensor located adjacent to the Relief Louver.
 4. Systems with Relief Air to the Mechanical Room: Pipe high-pressure tap to the discharge plenum using a pitot tube. Pipe the low-pressure port to the Mechanical Room adjacent to the Relief Damper.
 5. Return Duct Static Pressure. Pipe the low-pressure tap to the duct using a pitot tube. Pipe the high-pressure port to a tee in the high-pressure tap tubing of the corresponding building static pressure sensor (if present). If a building static pressure sensor is not present, pipe the high-pressure port to the location of the duct low-pressure tap and leave open to the plenum.
 6. Mixed Air Plenum Static Pressure. Pipe the low-pressure tap to the plenum using a pitot tube. Pipe the high-pressure port to a tee in the Outside Air static pressure sensor line.
 7. Building Static Pressure. Pipe the low-pressure port of the pressure sensor to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe the high-pressure port to a location designated by the Design Engineer and terminate to a Space Static Pressure Sensor wall or ceiling mounted.

- a. For spaces that do not have an operable outside opening, coordinate the space static pressure high and low sensing locations with the Engineer.
 - 8. The piping to the pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer.
 - 9. All pressure transducers, other than those controlling VAV boxes, shall be located in field device panels, not on the equipment monitored or on ductwork. Mount transducers in a location accessible for service without use of ladders or special equipment.
 - 10. All air and water differential pressure sensors shall have gauge tees mounted adjacent to the taps. Water gauges shall also have shut-off valves installed before the tee.
 - 11. If any pressure tubing length is more than 25 feet, contractor shall use 3/8" poly tubing.
 - K. Smoke detectors, freezestats (Low Temperature Detection), high/low-pressure cut-offs, damper end switches and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Pressure and Temperature Safety Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.
 - L. Install humidity sensors for duct mounted humidifiers at least 10 ft. downstream of the humidifier. Do not install filters between the humidifier and the sensor.
- 3.10 FLOW SWITCH INSTALLATION
- A. Use correct paddle for pipe diameter.
 - B. Adjust flow switch according to manufacturer's instructions.
- 3.11 ACTUATORS
- A. General. Mount and link control damper actuators according to manufacturer's instructions.
 - 1. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.
 - 2. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 - 3. Provide all mounting hardware and linkages for actuator installation.
 - B. Electric/Electronic
 - 1. Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° travel available for tightening the damper seal. Actuators shall be mounted following manufacturer's recommendations.
 - 2. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.
 - C. Fail Safe Position
 - 1. Confirm the Fail Safe positioning of all actuators with the Engineer.
- 3.12 WARNING LABELS
- A. Permanent warning labels shall be affixed to all equipment that can be automatically started by the control system.

1. Labels shall use white lettering (12-point type or larger) on a red background.
2. Warning labels shall read as follows.

CAUTION

This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect to "Off" position before servicing.

- B. Permanent warning labels shall be affixed to all motor starters and control panels that are connected to multiple power sources utilizing separate disconnects.

1. Labels shall use white lettering (12-point type or larger) on a red background.
2. Warning labels shall read as follows.

CAUTION

This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing.

3.13 IDENTIFICATION OF HARDWARE AND WIRING

- A. All wiring and cabling, including that within factory-fabricated panels shall be labeled at each end within 2 in. of termination with control system address or termination number.
- B. Permanently label or code each point of field terminal strips to show the instrument or item served.
- C. Identify control panels with minimum ½ in. letters on laminated plastic nameplates.
- D. Identify all other control components with permanent labels. All plug-in components shall be labeled such that label removal of the component does not remove the label.
- E. Identify room sensors related to terminal boxes or valves with nameplates.
- F. Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.
- G. Identifiers shall match record documents.

3.14 CONTROLLERS

- A. Provide a separate controller for each AHU or other HVAC system. A DDC controller may control more than one system provided that all points associated with the system are assigned to the same DDC controller. Points used for control loop reset, such as outside air or space temperature, are exempt from this requirement.
- B. Building Controllers and Custom Application Controllers shall be selected to provide the required I/O point capacity required to monitor all of the hardware points listed in the Sequence of Operation.

3.15 PROGRAMMING

- A. Provide sufficient internal memory for the specified sequences of operation and trend logging.
- B. Point Naming. The contractor shall be responsible for defining points in the JACE(s) in accordance with the Westside Community Schools Point Naming Standards, N4 Building Integration Guidelines, and the Westside Community Schools Alarming Standards, provided as Supplemental Documents.

- C. The Contractor shall submit a complete Points List containing the Description, Point Name (Acronym), Tag, Point Type, Unit of Measure, Facet Properties, Alarm Properties and Trend Properties, for approval prior to the start of any programming.
- D. The contractor shall expose and define in accordance with the Point Naming Standards ALL points available from Packaged Controllers (OEM) in the JACE(s) for potential integration into the N4 Supervisor.
- E. Software Programming.
 - 1. Provide programming for the system and adhere to the sequences of operation provided. All other system programming necessary for the operation of the system, but not specified in this document, also shall be provided by the contractor. Embed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation. Use the appropriate technique based on the following programming types:
 - a. Text-based:
 - 1) Must provide actions for all possible situations
 - 2) Must be modular and structured
 - 3) Must be commented
 - b. Graphic-based:
 - 1) Must provide actions for all possible situations
 - 2) Must be documented
 - c. Parameter-based:
 - 1) Must provide actions for all possible situations
 - 2) Must be documented.
 - 2. The Westside Community Schools District shall provide a Laptop on which the Contractor shall install all controller service software. The controller service software shall allow the technician to manually control all output points, read values of all input points and virtual points for all provided controllers. The Service software shall allow Westside Community Schools to edit, develop new or delete any custom programming. All required cabling and adapters shall be provided for the Laptop to interface to all provided field controllers. The Controls Contractor shall provide all software and adapters required at the time of Substantial Completion of this project. Any passwords or hardware keys shall be provided with the software at Substantial completion. Providing this software shall not void any warranty coverage for the installation of the Control Systems.

3.16 CONTROL SYSTEM CHECKOUT AND TESTING

- A. Startup Testing. All testing listed in this article shall be performed by the contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the owner's representative is notified that the system is ready for Commissioning.
 - 1. The contractor shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.
 - 2. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
 - 3. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures according to manufacturers' recommendations.
 - 4. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.

5. Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The contractor shall check all control valves and automatic dampers to ensure proper action and closure. The contractor shall make any necessary adjustments to valve stem and damper blade travel.
6. Verify that the system operation adheres to the sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules.
7. Tune all PID loops.
8. Alarms and Interlocks:
 - a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
 - b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
 - c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action
9. Contractor shall verify in writing to Westside Community Schools that all of the above requirements have been met.

3.17 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

A. Demonstration.

1. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed his/her own tests.
2. The tests described in this section are to be performed in addition to the tests that the contractor performs as a necessary part of the installation, start-up, and debugging process and as specified in the "Control System Checkout and Testing" article in Part 3 of this specification. The engineer, at their discretion, may be present to observe and review these tests. The engineer shall be notified at least 10 days in advance of the start of the testing procedures.
3. The demonstration process shall follow that approved in Part 1, "Submittals." The approved checklists and forms shall be completed for all systems as part of the demonstration.
4. The contractor shall provide at least two persons equipped with two-way communication and shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. The purpose is to demonstrate the calibration, response, and action of every point and system. Any test equipment required to prove the proper operation shall be provided by and operated by the contractor.
5. As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed.
6. Demonstrate compliance with Part 1, "System Performance."
7. Demonstrate compliance with sequences of operation through all modes of operation.
8. Contractor will be required to demonstrate both heating and cooling functionality in all equipment. Contractor shall include multiple site testing visits to demonstrate seasonal function of all systems.
9. Demonstrate complete operation of operator interface.
10. Additionally, the following items shall be demonstrated:
 - a. DDC loop response. The contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop's response to a change in set point, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the set point, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the Contractor.
 - b. Demand limiting. The contractor shall supply a trend data output showing the action of the demand limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30-

minute period. Included in the trend shall be building kW, demand limiting set point, and the status of sheddable equipment outputs.

- c. Optimum start/stop. The contractor shall supply a trend data output showing the capability of the algorithm. The change-of-value or change-of-state trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.
- d. Interface to the building fire alarm system.
- e. Operational logs for each system that indicate all set points, operating points, valve positions, mode, and equipment status shall be submitted to the architect/engineer. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in both printed and disk formats.

- 11. Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.

B. Acceptance.

- 1. All tests described in this specification shall have been performed to the satisfaction of both the engineer and owner, or owner's representative, prior to the acceptance of the control system as meeting the requirements of completion. Any tests that cannot be performed due to circumstances beyond the control of the contractor may be exempt from the completion requirements if stated as such in writing by the engineer. Such tests shall then be performed as part of the warranty.
- 2. The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1, "Submittals."

C. CLEANING

- D. 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.
- E. 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.
- F. 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 repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

G. TRAINING

- H. Provide training for a designated staff of Owner's representatives. Training shall be provided via self-paced training, web-based or computer-based training, classroom training, or a combination of training methods.
- I. Provide course outline and materials according to the "Submittals" article in Part 1 of this specification. Provide one copy of training material per student.
- J. The instructor(s) shall be factory-trained and experienced in presenting this material.
- K. Classroom training shall be done using a network of working controllers representative of installed hardware.
- L. Training sessions shall be video recorded for future use by the owner.

3.18 CONTROL VALVE INSTALLATION

- A. Valve submittals shall be coordinated for type, quantity, size, calculated Cv, pressure drop and piping configuration to ensure compatibility with pipe design.
- B. 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 so that the stem position is not more than 90 degrees from the vertical up position. Valves shall be installed in accordance with the manufacturer's recommendations.
- C. 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.
- D. 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.
- E. Provide tags for all control valves indicating service and number. Tags shall be brass, 1.5 inch in diameter, with ¼ inch high letters. Securely fasten with chain and hook. Match identification numbers as shown on approved controls shop drawings.

3.19 CONTROL DAMPER INSTALLATION

- A. Damper submittals shall be coordinated for type, quantity, and size to ensure compatibility with sheet metal design.
- B. 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.
- C. 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.
- D. 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.
- E. Ensure that mixing dampers are installed to provide the best possible blending of the two airstreams to minimize the possibility of stratification.
- F. Install extended shaft or jackshaft according to manufacturer's instructions. (Typically, a sticker on the damper face shows recommended extended shaft location. Attach shaft on labeled side of damper to that blade.)
- G. 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.
- H. Provide a visible and accessible indication of damper position on the drive shaft end.
- I. Support ductwork in area of damper when required to prevent sagging due to damper weight.
- J. After installation of low-leakage dampers with seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.

3.20 DUCT SMOKE DETECTION

- A. Submit data for coordination of duct smoke detector interface to HVAC systems as required in Part 1, "Submittals."
- B. This Contractor shall provide a dry-contact alarm output in the same room as the HVAC equipment to be controlled.

3.21 CONTROLS COMMUNICATION PROTOCOL

- A. General. The electronic controls packaged with this equipment shall communicate with the building energy management system (DDC). The DDC shall communicate with these controls to read the information and change the control setpoints as shown in the points list, sequences of operation, and control schematics. The information to be communicated between the DDC and these controls shall be in the standard object format as defined in ANSI/ASHRAE Standard 135 (BACnet). Controllers shall communicate with other BACnet objects on the internetwork using the Read (Execute) Property service as defined in Clause 15.5 of Standard 135.
- B. Distributed Processing. The controller shall be capable of stand-alone operation and shall continue to provide control functions if the network connection is lost.
- C. I/O Capacity. The controller shall contain sufficient I/ O capacity to control the target system.
- D. The Controller shall have a physical connection for a laptop computer or a portable operator's tool.
- E. Environment. The hardware shall be suitable for the anticipated ambient conditions.
 - 1. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures and shall be rated for operation at 40 °F to 140 °F.
 - 2. Controllers used in conditioned space shall be mounted in dust-proof enclosures and shall be rated for operation at 32 °F to 120 °F.
- F. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.
- G. Memory. The Controller shall maintain all BIOS and programming information in the event of a power loss for at least 30 days.
- H. Power. Controller shall be able to operate at 90% to 110% of nominal voltage rating.
- I. Transformer. Power supply for the Controller must be rated at minimum of 125% of ASC power consumption and shall be fused or current limiting type.

3.22 START-UP AND CHECKOUT PROCEDURES

- A. Start up, check out, and test all hardware and software and verify communication between all components.
 - 1. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
 - 2. Verify that all analog and binary input/output points read properly.
 - 3. Verify alarms and interlocks.
 - 4. Verify operation of the integrated system.
 - 5. Verify that all adjustable room temperature setpoints for cooling and heating have software High/Low setpoint limits in place. Limits are 70 Deg (LOW) to 75 Deg (HIGH). Wrestling rooms shall have 70 deg LOW, 80 Deg HIGH. Limits shall be adjustable only by administrator password level.

END OF SECTION 23 09 00

SECTION 23 09 60 – 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 01 Specification Sections, apply to this Section.
- B. The Owner has contracted directly with the Commissioning Authority (CxA) for this project. All Contractors shall co-operate with the CxA to complete all required commissioning. Specification Section 23 08 00 defines the Contractor's responsibilities with respect to the process. The Contractor shall review this section and shall include in their bids the work associated with the commissioning effort described.

1.2 SUMMARY

- A. This Section includes variable frequency drives for use on ac circuits rated 600 V and less.

1.3 SUBMITTALS

- A. Product Data: For products specified in this Section. Include dimensions, ratings, and data on features and components.
- B. Shop Drawings: For each variable frequency drive specified in this Section. Include dimensioned plans, elevations, and component lists.
 - 1. Schedule of features, characteristics, ratings, and factory settings of individual motor-control center units.
 - 2. Wiring Diagrams: Interconnecting wiring diagrams pertinent to class and type specified for drive. Schematic diagram of each type of controller unit indicated.
- C. Maintenance Data: For products to include in maintenance manuals.
- D. See "Submittal Schedule" located at the end of Section 23 01 00 "General Requirements for Mechanical Systems."

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. Source Limitations: Obtain variable frequency drives through one source from a single manufacturer.
- C. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store so condensation will not occur on or in variable frequency drives. Provide temporary heaters as required to prevent condensation.

1.6 COORDINATION

- A. Coordinate features of controllers and accessory devices with pilot devices and control circuits to which they connect.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace VFDs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Asea Brown Boveri (ABB)
 - 2. Allen Bradley
 - 3. Danfoss
 - 4. Reliance Electric HVAC Drive
 - 5. Siemens Industry
 - 6. Yaskawa Electric America

2.2 VARIABLE-FREQUENCY CONTROLLERS

- A. Description: NEMA 1, variable-frequency controller, listed and labeled as a complete unit and arranged to provide variable speed of a energy efficient NEMA MG 1, Design B, 3-phase, induction motor by adjusting output voltage and frequency.
- B. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- C. Starting Torque: 100 percent of rated torque or as indicated.
- D. Speed Regulation: Plus or minus one percent.
- E. Ambient Temperature: 0 to 40 deg C.
- F. Efficiency: 95 percent minimum at full load and 60 Hz.
- G. Isolated control interface allows controller to follow 1 of the following over an 11:1 speed range:
 - 1. Electrical Signal: 4 to 20 mA at 24 V, 0 to 5 VDC, 0 to 10 VDC
- H. Internal Adjustability: Include the following internal adjustment capabilities:
 - 1. Minimum Speed: 5 to 25 percent of maximum rpm.
 - 2. Maximum Speed: 80 to 100 percent of maximum rpm.
 - 3. Acceleration: 2 to 22 seconds.

4. Deceleration: 2 to 22 seconds.
 5. Current Limit: 50 to 110 percent of maximum rating.
- I. Self-protection and reliability features include the following:
1. Input transient protection by means of surge suppressors.
 2. Snubber networks to protect against malfunction due to system voltage transients.
 3. Motor Overload Relay: Adjustable and capable of NEMA 250, Class 10 performance.
 4. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
 5. Instantaneous overcurrent trip.
 6. Loss of phase protection.
 7. Reverse phase protection.
 8. Under- and overvoltage trips.
 9. Overtemperature trip.
 10. Short-circuit protection.
 11. Under load supervision (belt loss detection).
 12. Ground Fault.
- J. Automatic Reset/Restart: Attempt 3 restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Restarting during deceleration will not damage controller, motor, or load.
- K. Power-Interruption Protection: Prevents motor from reenergizing after a power interruption until motor has stopped.
- L. Status: Front panel mounted LED screen to provide selectable readouts to indicate the following conditions:
1. Power on.
 2. Run status.
 3. Output voltage.
 4. Output current.
 5. Output frequency.
 6. DC buss voltage.
 7. Motor current.
 8. Speed (RPM).
 9. kWh.
 10. Calculated motor power (kW)
 11. Overvoltage.
 12. Line fault.
 13. Overcurrent.
 14. External fault
- M. Front Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control adjustment and lapsed time meter.
- N. Integral fused disconnect.
- O. Phase loss protection relay.
- P. EMI and RFI Filters for harmonics control.
- Q. Direct digital control interface card in communication protocol BACnet MS/TP coordinated with temperature control contractor.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Select features of each motor controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.
- B. Select horsepower rating of controllers to suit motor controlled.

3.2 INSTALLATION

- A. Furnish Variable frequency drives to electrical contractor for installation.
 - 1. Fuses: Furnish fuses for each fusible disconnect.
- B. All Power wiring shall be by electrical contractor per Division 26 specifications.

3.3 CONTROL WIRING INSTALLATION

- A. Temperature control contractor shall install wiring between variable frequency drives and control devices or energy management system.
- B. Bundle, train, and support wiring in enclosures.

3.4 FIELD QUALITY CONTROL

- A. Provide factory authorized representative to start drive and set operating parameters.
- B. Training: Engage a factory-authorized service representative to demonstrate variable-speed controllers and train Owner's maintenance personnel.
 - 1. Provide videotape of training session to Owner.
 - 2. Schedule training with at least 7 days' advance notice.

END OF SECTION 23 09 60

SECTION 23 09 93 - SEQUENCE OF OPERATION 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 01 Specification Sections, apply to this Section.
- B. Section 23 09 00 "HVAC Instrumentation and Controls" for control equipment and devices and for submittal requirements.
- C. Section 23 09 60 "Variable Frequency Drives."
- D. The Owner will select and employ the Commissioning Authority (CxA) for this project. All Contractors shall cooperate with the CxA to complete all required commissioning. Specification Section 23 08 00 defines the Contractor's responsibilities with respect to the process. The Contractor shall review this section and shall include in their bids the work associated with the commissioning effort described.

1.2 SUMMARY

- A. This Section includes control sequences for the following HVAC systems, subsystems, and equipment. Sequences of Control indicate basic control function only. Provide all control devices required for controlling air handling units, exhaust fans, physical plant equipment, terminal equipment, and all related items.
- B. The Control Contractor shall perform the initial input of all required operational data for each point that is to be used based on information supplied to the Contractor by the Owner. The Contractor shall assist the Owner's staff in developing the schedule and shall demonstrate the operation of the system using the data.
- C. Provide adequate English language notation in the software to assist the operator in understanding the intent of the programmed sequences.
- D. The Control Contractor shall be responsible for the stable operation of all control loops. If the Control Contractor has not provided self-tuning PID control algorithms then the Control Contractor shall manually tune all control loops. Verify all control loops are stable whether or not they are self-tuning.
- E. The Control Contractor shall provide any modifications to the operating sequences as requested by the Owner without additional costs until the final acceptance of the entire control system.
- F. Related Sections include the following:
 - 1. Division 23 Section 23 09 00 "HVAC Instrumentation and Controls" for control equipment and devices and for submittal requirements.

1.3 DEFINITIONS

- A. BAS: Building Automation System.
- B. DDC: Direct Digital Controls (a subset of the BAS)
- C. PID: Proportional-integral-derivative.

D. Points List:

1. AI = Analog Input
2. AO = Analog Output
3. BI = Binary Input
4. BO = Binary Output
5. HI = Indicated a hardwired interface requirement. These points are not monitored by the BAS unless indicated in any of the previous columns.
6. AV = Analog Value. A software point that may be editable or read-only.
7. BV = Binary Value. A software point that may be editable or read-only.
8. Trend = The BAS shall be configured to collect and display a trend log of this object.
 - a. Temperature points: Initially set to sample data every 15 minutes unless noted otherwise.
 - b. Pressure points: Initially set to sample data every 1 minute unless noted otherwise.
 - c. Binary points: Initially set to sample data anytime there is a change of value.
9. Alarm = The BAS shall be configured to generate an alarm when this object exceeds user definable limits, as described in the Sequence of Controls.

E. Abbreviations: The following abbreviations may be used in graphics, schematic, point names, and other applications where space is limited.

1. AC - Air Conditioning
2. ACU - Air Conditioning Unit
3. AHU - Air Handling Unit
4. BYP - Bypass
5. CO – Carbon Monoxide
6. CO₂ – Carbon Dioxide
7. COND - Condenser
8. CW - Condenser Water
9. CWP - Condenser Water Pump
10. CWR - Condenser Water Return
11. CWS - Condenser Water Supply
12. DA - Discharge Air
13. DP – Differential Pressure
14. DMP - Damper
15. EA - Exhaust Air
16. EF - Exhaust Fan
17. EVAP - Evaporators
18. FCU - Fan Coil Unit
19. HOA - Hand / Off / Auto
20. HP - Heat Pump
21. HRU - Heat Recovery Unit
22. HW - Hot Water
23. HWP - Hot Water Pump
24. HWR - Hot Water Return
25. HWS - Hot Water Supply
26. MAX - Maximum
27. MIN - Minimum
28. NO₂ – Nitrogen Dioxide
29. OAT - Outdoor Air Temperature
30. OAH – Outdoor Air Humidity
31. RA - Return Air
32. RAT – Return Air Temperature
33. RF - Return Fan
34. RH - Relative Humidity

- 35. SA - Supply Air
- 36. SAT – Supply Air Temperature
- 37. SF - Supply Fan
- 38. SP - Static Pressure
- 39. TEMP - Temperature
- 40. UH - Unit Heater
- 41. UV - Unit Ventilator
- 42. VAV - Variable Air Volume
- 43. VFD – Variable Frequency Drive
- 44. WSHP - Water Source Heat Pump

1.4 SEQUENCES OF OPERATION

- A. See “Mechanical Control Diagram” on Sheet M5.01.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 23 09 93

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes piping, special-duty valves, and hydronic specialties for condenser water systems and makeup water for these systems.

1.3 SUBMITTALS

- A. Product Data: For each type of special-duty valve indicated. Include flow and pressure drop curves based on manufacturer's testing for diverting fittings, calibrated balancing valves, and automatic flow-control valves.
- B. Field Test Reports: Written reports of tests specified in Part 3 of this Section.
- C. Maintenance Data: For hydronic specialties and special-duty valves to include in maintenance manuals.
- D. See "Submittal Schedule" located at the end of Section 23 01 00 "General Requirements for Mechanical Systems."

1.4 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to the applicable codes.
- B. 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.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Heat Pump Loop System: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:
 - 1. Notify Construction Manager and Owner no fewer than two weeks in advance of proposed interruption of sanitary waste service.
 - 2. Do not proceed with interruption of hydronic systems without Construction Manager's and Owner's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Grooved Mechanical-Joint Fittings and Couplings:
 - a. Central Sprinkler Company; Central Grooved Piping Products.
 - b. Grinnell Corporation.
 - c. Victaulic Company of America.
 - d. Star Fittings
2. Calibrated Balancing Valves:
 - a. Armstrong Pumps, Inc.
 - b. Flow Design, Inc.
 - c. Gerand Engineering Company.
 - d. Griswold Controls.
 - e. ITT Bell & Gossett; ITT Fluid Technology Corp.
 - f. Nexus Valve
 - g. Taco, Inc.
 - h. Pro Hyrdonics Specialties
 - i. Oventrop
3. Pressure-Reducing Valves:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Conbraco Industries, Inc.
 - d. ITT Bell & Gossett; ITT Fluid Technology Corp.
 - e. Spence Engineering Company, Inc.
 - f. Watts Industries, Inc.; Watts Regulators.
4. Safety Valves:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Conbraco Industries, Inc.
 - d. ITT McDonnell & Miller Div.; ITT Fluid Technology Corp.
 - e. Kunkle Valve Division.
 - f. Spence Engineering Company, Inc.
 - g. Wheatley
5. Automatic Flow-Control Valves:
 - a. Flow Design, Inc.
 - b. Griswold Controls.
 - c. Hays Fluid Controls
 - d. Nexus
 - e. NuTech
 - f. Pro Hyrdonics Specialties
 - g. Oventrop
6. Expansion Tanks:
 - a. American Wheatley HVAC Products
 - b. Amtrol, Inc.
 - c. Armstrong Pumps, Inc.

- d. Bell & Gossett;
- e. Taco, Inc.
- f. The John Wood Company
- g. Thrush

7. Air Separators:

- a. American Wheatley HVAC Products
- b. Amtrol, Inc.
- c. Armstrong Pumps, Inc.
- d. ITT Bell & Gossett; ITT Fluid Technology Corp.
- e. Taco, Inc.
- f. The John Wood Company
- g. Thrush
- h. Spirotherm
- i. Wessels

8. Glycol Make-Up Packages

- a. American Wheatley
- b. J.L. Wingert
- c. Vector
- d. Wessels

9. Geothermal High Density Polyethylene Pipe and Fittings:

- a. Performance Pipe
- b. Phillips Driscopipe, Inc.
- c. Vanguard Plastics, Inc.
- d. Centennial Plastics

2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
- C. Wrought-Copper Fittings: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32, 95-5 tin antimony.
- E. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver).

2.3 STEEL PIPE AND FITTINGS

- A. Steel Pipe, NPS 2 and Smaller: ASTM A 53, Type S (seamless) or Type F (furnace-butt welded), Grade A, Schedule 40, black steel, plain ends.
- B. Steel Pipe, NPS 2-1/2 through NPS 12: ASTM A 53, Type E (electric-resistance welded), Grade A, Schedule 40, black steel, plain ends.
- C. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250.

- D. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
- E. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.
- F. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced.
- G. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- H. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets.
- I. Grooved Mechanical-Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47, Grade 32510 malleable iron; ASTM A 53, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders designed to accept grooved end couplings.
- J. 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.
- K. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.
- L. Outlet Fittings: Sockolet or Thredolet fittings are acceptable for 90-degree branch take-offs. Fittings must comply with ASTM A105, A182, and A403 and be made of same material and wall thickness as pipe in which they are installed.

2.4 VALVES

- A. Check, ball, and butterfly valves are specified in Division 23 Section "Valves for HVAC."
- B. Refer to Part 3 "Valve Applications" Article for applications of each valve.
- C. Calibrated Balancing Valves, NPS 2 and Smaller: Bronze body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having threaded ends. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.
- D. Calibrated Balancing Valves, NPS 2-1/2 and Larger: Cast-iron or steel body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having flanged or grooved connections. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.
- E. Pressure-Reducing Valves: Diaphragm-operated, bronze or brass body with low inlet pressure check valve, inlet strainer removable without system shutdown, and noncorrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory set at operating pressure and have capability for field adjustment.
- F. Safety Valves: 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.

2.5 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.
- C. Expansion Tanks: Welded carbon steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Separate air charge from system water to maintain design expansion capacity by a flexible bladder securely sealed into tank. Include drain fitting and taps for pressure gage and air-charging fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Factory fabricate and test tank with taps and supports installed and labeled according to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
- D. Air Eliminator and Dirt Separator:
 - 1. Unit shall be ASME stamped and fabricated steel, rated for 150 psig working pressure.
 - 2. Unit shall include a brass conical shaped air venting chamber designed to minimize system fluid from fouling the venting assembly.
 - 3. Provide with separate venting chamber to prevent system contaminants from harming the float and venting valve operation. Include side tap to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill.
 - 4. Separators shall remove air down to 18 microns and shall remove dirt/debris down to 5 microns. The unit shall be 100% efficient at removing dirt down to 150 microns in 10 passes or less at 3.5ft/sec. Dirt separation, minimum of 80% of particles 30 microns and larger removed within 100 passes at no less than 3.5 feet per second velocity. (Supported by testing from an independent facility).

2.6 CLOSED SYSTEM EQUIPMENT

- A. Glycol Make-up Package: Fully automated and autonomous. Complete with: low level cut-off and alarm arrangement including a 110V signal for remote alarm, isolation valves, strainer, pressure tank with pressure control, pressure reducing valve and gauge, translucent polyethylene solution container with lid designed to accommodate relief valve piping, magnetic starter, 110V, 60Hz motor and controls. All mounted on a sturdy steel frame with 1/2" system connection and factory preset 12psig (field adjustable) discharge.
- B. Y-Pattern Strainers: 125-psig working pressure; cast-iron body (ASTM A 126, Class B), flanged ends for NPS 2-1/2 and larger, threaded connections for NPS 2 and smaller, bolted cover, perforated stainless-steel basket, and bottom drain connection.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Heat Pump Loop Piping (HPLS & HPLR)
 - 1. NPS 2 and Smaller:
 - a. Type L drawn-temper copper tubing with soldered joints
 - b. Schedule 40 steel pipe with threaded joints.
 - 2. NPS 2-1/2 and Larger: Schedule 40 steel pipe with welded joints, flanged joints or grooved mechanical-joint couplings.

- B. Condenser Water (CS & CR)
 - 1. Inside the building - Schedule 40 steel pipe with welded and flanged joints or grooved mechanical-joint couplings.
 - 2. Outside in enclosure - Schedule 80, PVC pipe with solvent-welded joints.
 - 3. Below grade – see specification section 232114 – Below-grade Condenser Water Piping
- C. Condensate Drain Lines (CD)
 - 1. Type L drawn-temper copper tubing with soldered joints

3.2 VALVE APPLICATIONS

- A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:
 - 1. Shutoff Duty:
 - a. Gate valves.
 - b. Ball valves.
 - c. Butterfly valves.
 - 2. Throttling Duty:
 - a. Globe valves.
 - b. Ball valves.
 - c. 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 automatic or manual balancing valves in the return water line of each heating or cooling element and elsewhere as required to facilitate system balancing.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. Install safety valves on hot-water generators and elsewhere as required by the ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to floor. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements.
- F. Install pressure-reducing valves on hot-water generators and elsewhere as required to regulate system pressure.

3.3 PIPING INSTALLATIONS

- A. Refer to Division 23 Section "Basic Mechanical Piping Materials and Methods" for basic piping installation requirements.
- B. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- C. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- D. Install drain piping at a uniform grade of 2.0 percent in direction of drain.

- E. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- F. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- G. Anchor piping for proper direction of expansion and contraction.

3.4 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents in mechanical equipment rooms only at high points of system piping, at heat-transfer coils, and elsewhere as required for system air venting.
- C. Install in-line air separators in pump suction lines. Install piping to compression tank with a 2 percent upward slope toward tank. Install drain valve on units NPS 2 and larger.
- D. Install combination air separator and strainer in pump suction lines. Install piping to compression tank with a 2 percent upward slope toward tank. Install blowdown piping with gate valve; extend to nearest drain.
- E. Install expansion tanks on floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system design requirements.
- F. Install Glycol Make-up package per Manufacturer's recommendation. Provide 3/4" connection from pump discharge. Provide all required control wiring for a complete operational system.

3.5 CHEMICAL TREATMENT

- A. See Section 23 25 00 "HVAC Water Treatment."
- B. Perform an analysis of supply water to determine the type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling.
- C. Fill system and perform initial chemical treatment.
- D. Fill condenser loop system with industrial inhibited propylene glycol and water solution to provide freeze protection down to 0°F and burst protection down to -30°F. Typically 40% Propylene Glycol Solution.

3.6 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 system with clean water. Clean strainers.
 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.
 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 trapped air. Use drains installed at low points for complete draining of liquid.
3. Check expansion tanks to determine that they are not air bound and that system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design 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 either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of 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. Cleaning of Piping:

1. Cleaning of piping shall be completed after hydrostatic testing or prior to final acceptance of the system.
2. The Contractor shall be responsible for providing all materials, labor, pumps, filters (minimum of 25 micron filter located at the pump), and all other equipment or devices necessary to clean the system piping including obtaining applicable permits and payment of fees to authorities having jurisdiction.
3. The contractor shall submit the pump performance curve and filter data a minimum of 10 working days prior to commencing the system cleaning. The pump shall have sufficient capacity to generate a flow velocity of 5 feet per second through the piping being cleaned.
4. The Contractor shall furnish and install all temporary spool pieces required to connect the supply and return piping in the system so that a complete loop is established for flushing.
5. Remove internal screens of all equipment wye-strainers.
6. The system shall be filled with clean, ambient temperature water of equal or better quality than that provided by the City of Omaha for distribution to the public. Use vents installed at high points of the system to release air while filling the system.
7. Add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from the piping. The concentration of chemical added shall be as recommended by the chemical manufacturer. Provide temporary chemical feeders, complete with all valves, piping and accessories required to introduce chemicals into the system.
8. Bypass system coils as recommended by manufacturer. See detail on plans for additional information.
9. Use neutralizer agents on recommendation of system cleaner supplier and approval of Owner.
10. Flush open systems with clean water for one hour minimum. Drain completely and refill.
11. Remove, clean and replace strainer screen[s].
12. Inspect, remove sludge and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.
13. Add final chemical treatment. See 232500 for treatment chemicals. The chemical treatment company will inject the final chemicals into the system based on their analysis. Once the system is filled with the final chemicals it is important that the water is not to be left stagnant.

3.7 START-UP

A. Perform these adjustments before operating the system:

1. Fill system with water and required chemicals and/or antifreeze solution.
2. Start pump and check pump for proper direction of rotation.
3. Set automatic fill valves for required system pressure.
4. Check air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).

END OF SECTION 23 21 13

SECTION 232114 – BELOW-GRADE CONDENSER WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes piping and hydronic specialties for condenser water systems routed below grade.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for piping materials, valves, hangers, pressure and temperature test ports, thermometers, pressure gauges, backfill material (grout), joining methods and propylene glycol solution.
- B. "As-Built Drawing" with dimensioned piping routing including location measured from permanent fixture such as corner of building, fire hydrant, etc.
- C. See "Submittal Schedule" located at the end of Section 230100 "General Requirements for Mechanical Systems."

1.4 QUALITY ASSURANCE

- A. Qualification of installing Contractors
 - 1. Pipe Installer's Qualifications: Installers shall have at least three (3) years of successful installation experience on projects with work similar to that required for this project.

1.5 WARRANTY

- A. Special Project Warranty: installation Contractor shall submit a written warranty with operation and maintenance data. Warranty shall provide for repair and/or replacement of pipe and fittings due to failure in workmanship within the specified warranty period. Warranty period shall be for a minimum of five (5) years from date of Substantial Completion and shall cover both materials and labor as required for pipe, fittings, backfilling material, trenching, etc. Note that this warranty shall be provided in addition to the pipe and fitting material warranty provided by the manufacturer. Both the installation warranty and the pipe manufacturer warranty shall be transferable.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. High Density Polyethylene Pipe and Fittings:
 - 1. Performance Pipe

2. Phillips Driscopipe, Inc.
3. Vanguard Plastics, Inc.
4. Centennial Plastics

2.2 LOOP HEAT EXCHANGER PIPING

- A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in condenser water piping. Where more than one type of materials or products are indicated, selection is installer's option.
- B. Condenser Water Piping (Below Grade)
 1. Material: Piping shall be extruded high density polyethylene (HDPE) conforming to the specifications and requirements of ASTM D3035. The pipe shall be virgin resin with an allowance for on-site manufacturer re-processed resin. No recycled resin shall be used. Pipe shall be inert to most chemical compounds. Heat transfer fluids such as propylene glycol, methanol, sodium chloride and calcium chloride shall have no effect on the pressure capability or long-term performance of the pipe. The pipe shall not rust, rot, pit, corrode or otherwise react to highly corrosive soils into which it may be placed.
 2. Resins exhibiting the balance of properties offered by pipe-grade resin possessing the ASTM D3350 PE3408 cell classification no. 345434C.
 3. The system pipe fittings which are molded shall be manufactured to the dimensional specifications and requirements of ASTM D2683 (for socket fusion fittings) or ASTM D3261 (for butt/saddle fusion fittings). Minimum dimensional ratio for piping shall be SDR11 with a minimum working pressure rating of 160 psi at 73 degrees F.
 4. The material used in the manufacturing of the fitting shall be the same approved extrusion material as the connecting pipe. Pipe and fittings shall be approved by pipe manufacturer as meeting requirement of this specification. For fabricated fittings, a minimum "quick-burst" strength of the fittings shall not be less than that of the pipe, nor less than four times the long-term water-rated working pressure.
 5. All fittings shall be field pressure tested to 100 psig before backfilling. Installer shall record each piping pressure test in a log book to be submitted as part of the project record documents.
 6. Joining Method: The approved joints are socket or butt heat fusion, flanging, transition fittings and proof-tested, approved mechanical "couplers".

2.3 UNDERGROUND-TYPE PLASTIC LINE MARKERS

- A. General: Manufacturer's standard permanent, bright-colored; continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide and 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried pipe.
 1. Provide multi-ply tape consisting of solid aluminum foil core between two layers of plastic tape.

2.4 ANTIFREEZE SOLUTION

- A. Propylene Glycol: Minimum 40 percent propylene glycol with corrosion inhibitors and environmental stabilizer additives to be mixed with water to protect the piping circuit and connected equipment from physical damage from freezing or corrosion.
- B. Quantity: Sufficient solution for initial system startup and for preventative maintenance for one year from date of Substantial Completion.

- C. Dilution Water: Chloride content shall be less than 25 ppm, sulfate less than 25 ppm, and hardness less than 100 ppm.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which ground loop exchanger water piping materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.
- B. Carefully inspect the pipe to detect any damage that may have occurred during shipping or as a result of excessive abuse at the job site.

3.2 COORDINATION

- A. Sequence, coordinate and integrate installation of piping materials for efficient flow of the work. Give particular attention to large equipment or piping requiring positioning prior to termination with building or enclosure.
- B. Coordinate the work of the building general contractor, such that, interference between mechanical, electrical, architectural, and structural work, including existing services, will be avoided.

3.3 IDENTIFICATION OF BELOW-GRADE PIPING

- A. Each pipe shall be permanently indent marked with the manufacturer's name, nominal size, pressure rating, relevant ASTM standards, cell classification number and date of manufacture. Each fitting shall be identified with the manufacturer's name, nominal size, pressure rating, relevant ASTM standards and date of manufacture.
- B. Provide underground plastic tape pipe markers. Install tape 6-18 inches below finished grade, immediately above all horizontal pipe runs.
- C. Attach coated 14 GA copper trace wire along entire length of all underground polyethylene pipe and terminate in the building mechanical room.

3.4 INSTALLATION OF CONDENSER WATER PIPING (BELOW GRADE)

- A. General: Install underground piping as indicated and in accordance with manufacturer's written instructions. Lay underground piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Make welded fittings in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Clean interior piping of dirt and other superfluous material as work progresses. Maintain swab or drag in line and pull past each joint as it is completed. Place plugs in ends of uncompleted piping at end of day or whenever work stops.
- B. Construction and installation shall be in accordance Division 31 for trench construction, embedment material, bedding, haunching, initial backfill and final cover.
- C. Excavation, Laying Pipe and Backfilling (Refer to Division 31)
 - 1. Civil contractor shall perform all excavation and backfilling necessary to install the required mechanical work. Coordinate the work with other excavating and backfilling work in the same area.

2. Grade the bottom of the trenches accurately to provide uniform bearing and support for each section of the pipe on undisturbed soil at every point along its entire length.
 3. All horizontal outdoor piping shall be buried a minimum of 60 inches deep. If the soil contains sharp rocks, dig the trench 12 inches deeper than required and install a base of 12 inches of suitable backfill before placing the pipe.
 4. Provide rounded corners at changes of direction and at trench "tees". Any kinks or sharp bends in the piping are not acceptable. Install elbow fittings for bends which require tighter radii than manufacturer recommends.
 5. The full length of each pipe section shall rest solidly upon the pipe bed. Keep pipe interior clean and dry during laying operations. When work is not in progress, plug the ends or close them by another acceptable method. Do not lay pipe in water and keep water out of trench until joining is complete. Provide valves, plugs, or caps, as required, where pipe ends are left for future connections.
 6. Deposit suitable granular sand backfill material under the pipe in 6 inch layers and thoroughly compact. Provide a minimum of 4 inch sand bed, or 1/8 of pipe outside diameter, whichever is greater. Provide tamped granular sand backfill in 6 inch layers to a minimum 12 inches above top of pipe. Be careful not to disturb the pipe. Carry backfilling simultaneously on both sides of pipe to eliminate the possibility of lateral displacement.
 7. After the piping is installed, tested, inspected and approved while still under pressure, deposit suitable backfill material in layers and thoroughly compact in accordance with appropriate Division 31 sections. Insure that no sharp rocks come into contact with any pipe walls. Coordinate the laying of the header piping with all existing new site utilities as well as landscape plans.
- D. Join the pipe and fittings using the butt or socket fusion process. Allow joints to cool for 3 hours before exposure to cold joint testing or pressure testing.
- E. Any kinks or sharp bends in the piping are not acceptable. Continuous length pipe is recommended for change of directions (no butt or socket fusion joints). Consult pipe manufacturer for minimum bend radius. Install elbow fittings for bends which require tighter radii than manufacturer recommends.
- F. Care should be taken to make sure the total system pressure, operating plus surge, does not exceed the pressure rating of pipe.
- G. To ensure long-term performance, pipe should be installed strictly in accordance with accepted engineering design methodology and in accordance with the manufacturer's installation instructions.
- H. Lateral pipes shall be purchased in such lengths and installed in such manner as to minimize the number of fusion joints required.
- I. Lateral piping supply and return lines or bundles shall be separated to minimize thermal interference between the two. The number of points where supply and return lines cross one another shall be minimized.
- J. Slope lateral piping to provide venting. Slope pipe upward in direction of flow.
- K. Open ends of all lateral pipe shall be sealed to prevent the entry of contaminants until final connections are made.
- L. Prior to backfilling, the piping system shall be pressure tested. Testing shall be by air or water pressure, at 100 psig. The duration of the test and acceptance criteria shall be specified in pipe manufacturer's written pressure testing instructions. Exercise suitable safety precautions during testing, to guard against injury to personnel near lines being tested, in case of pipe system component, or joint failure under pressure. Results of all tests shall be recorded and supplied to the Owner upon completion of the project, or as required by the Owner.
- M. Connect loop field piping to the supply/return header system as shown on the plans.

3.5 ANTIFREEZE SOLUTION FILL

- A. Fill system with required quantity of 40% propylene glycol and water to provide minus 20 deg F freezing temperature.
- B. Test the dilute solution using gas chromatography to verify concentration of propylene glycol, and forward report to Architect.

3.6 FIELD QUALITY CONTROL

- A. Cold Joint Testing
 - 1. All fusion joints shall be tested for cold joints prior to pressure testing and backfilling. Cold joint test shall consist of compressing pipe approximately one inch from fusion joint. Separation of joint or subsequent leak during pressure test shall indicate cold joint. All cold joints shall be repaired and retested prior to backfilling. All joints which fail the cold joint test shall be recorded and supplied to the Owner upon completion of the project, or as required by the Owner.
- B. Upon completion of piping installation, perform complete hydrostatic pressure test per polyethylene pipe manufacturer's written instructions, and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during the test.
 - 2. Provide temporary restraints where required. If temporary restraints are not practical, isolate expansion joints from testing.
 - 3. Flush system with clear water.
 - 4. Isolate equipment that is not to be subjected to the test pressure from the piping. If a valve is used to isolate the equipment, its closure shall be capable of sealing against the test pressure without damage to the valve. Flanged joints at which blinds are inserted to isolate equipment need not be tested.
 - 5. Install relief valve set at pressure no more than 1/3 higher than test pressure to protect against damage by expansion of liquid or other source of over-pressure during the test.
 - 6. Use ambient water temperature as a testing medium except where there is risk of damage due to freezing. Another liquid may be used if it is safe for work persons and compatible with the piping system components.
 - 7. Use vents to release trapped air while filling the system.
 - 8. Examine system to see that equipment and parts that cannot withstand test pressure are properly isolated.
 - 9. Subject piping system to a hydrostatic test pressure which at every point in the system is not less than 1.5 times the normal operating pressure. The test pressure shall not exceed the maximum pressure for any vessel, pump, valve or component on the system under the test.
 - 10. After the hydrostatic test pressure has been applied for at least ten minutes, examine the piping joints and connections for leakage. Eliminate leaks by tightening, repairing or replacing components as appropriate and repeat hydrostatic test until there are no leaks.
 - 11. Owner shall verify acceptance of the pressure test.
 - 12. Clean and flush piping system.

3.7 ADJUSTING, CLEANING, AIR PURGING, AND FILLING

- A. The mechanical contractor shall be responsible for flushing, purging, cleaning and filling all of the outside piping. Outside piping is defined as all ground coupled heat pump loop external to the building and installed as part of this Contract.
- B. Flushing, Testing and Cleaning
 - 1. Cleanliness: During installation, trash, soil and small animals shall be kept out of the pipe. Ends of the pipe shall be capped until the pipe is joined to the circuit.
 - 2. Pressurizing: The horizontal piping system shall be water filled and pressure tested by zone as specified in this Section prior to back fill of the trenches. Every joint and fitting shall be visually and physically examined.

Notify Owner 48 hours before test. Make note of test in log book mentioned previously in this specification. Record test duration, pressures, etc.

C. Air Purging

1. The hydronic system shall be purged of all air by bleeding air from all high spots and circulating water through the system for minimum of 48 hours.
2. Prior to backfilling, the complete loop field piping system shall be purged of air and flow tested to ensure proper water flow in all portions. A portable temporary purging unit shall be utilized and consist of the following: Purge Pump-high volume and high head; open reservoir, filter assembly with bypass; connecting piping, and connection hoses.
3. Using the purging unit described above, flush and purge piping until free of air, dirt and debris. A minimum velocity of 2 ft./sec. is required in all pipe sections to remove the air. The flush and purge water velocity shall not exceed 7 ft./sec. This flushing and purging operation should be conducted with the water source heat pump piping isolated with shut off valves. **Do not flush and purge through the heat pump loop.** Coordinate with the building mechanical contractor (Do not allow the acid solution used to purge and flush the indoor metal pipe system to the heat pump units to become mixed with the solution in the condenser water loop).
4. Utilizing the purging unit, conduct a pressure and flow test on the completed piping to ensure the system is free of blockage. If the flow test indicates blockage, locate the blockage systematically clamping off loops with a pinch-off tool or using the shut-off valves, remove the blockage, then repurge and conduct the pressure and flow test again until all portions of the system are flowing. The flow test must be observed and approved by the Owner.
5. The inspection report is to be filled out by the Contractor and is to be witnessed by the Owner Representative.

D. Filling

1. Once all pressure testing, flushing, and air purging has been complete, the piping shall be filled with a mixture of water and propylene glycol solution as specified.

- E. System Startup: Prior to heating and cooling system startup by the building mechanical contractor, ensure all valves are in correct position and piping is unblocked and leak free prior to system startup. The mechanical Contractor shall be present at and coordinate with the building mechanical contractor during building mechanical system startup.

END OF SECTION 23 21 15

SECTION 23 21 23 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Owner will select and employ the Commissioning Authority (CxA) for this project. All Contractors shall cooperate with the CxA to complete all required commissioning. Specification Section 23 08 00 defines the Contractor's responsibilities with respect to the process. The Contractor shall review this section and shall include in their bids the work associated with the commissioning effort described.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Separately coupled, base-mounted, end-suction centrifugal pumps.

1.3 DEFINITIONS

- A. Buna-N: Nitrile rubber.
- B. EPT: Ethylene propylene terpolymer.

1.4 SUBMITTALS

- A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.
- B. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.
- D. See Submittal Schedule located at the end of Section 23 01 00 "General Requirements for Mechanical Systems."

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of hydronic pumps and are based on the specific system indicated.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. UL Compliance: Comply with UL 778 for motor-operated water pumps.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SEPARATELY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS

- A. Manufacturers:
 - 1. Armstrong Pumps Inc.
 - 2. Aurora Pump; Division of Pentair Pump Group.
 - 3. Bell & Gossett; Div. of ITT Industries.
 - 4. FloFab.
 - 5. MEPCO (Marshall Engineered Products Co.).
 - 6. PACO Pumps.
 - 7. Scot Pump; Div. of Ardox Corp.
 - 8. Taco, Inc.
 - 9. Thrush Company Inc.
 - 10. Weinman; Div. of Crane Pumps & Systems.
- B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in HI 14.1-14.2 and HI 14.3; designed for base mounting, with pump and motor shafts horizontal. Rate pump for 125-psig minimum working pressure and a continuous water temperature of 200 deg F.
- C. Pump Construction:
 - 1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and threaded companion-flange or flanged connections. Provide integral mount on volute to support the casing, and attached piping to allow removal and replacement of impeller without disconnecting piping or requiring the realignment of pump and motor shaft.
 - 2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
 - 3. Pump Shaft: Steel, with copper-alloy shaft sleeve or stainless steel.
 - 4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket.
 - 5. Pump Bearings: Grease-lubricated ball bearings contained in cast-iron housing with grease fittings.
- D. Shaft Coupling: Molded rubber insert and interlocking spider capable of absorbing vibration. Couplings shall be drop-out type to allow disassembly and removal without removing pump shaft or motor. EPDM coupling sleeve for variable-speed applications.
- E. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.

- F. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.
- G. Motor: Single speed, with lubricated ball bearings, unless otherwise indicated; secured to mounting frame, with adjustable alignment. Comply with requirements in Division 23 Section "Basic Mechanical Materials and Methods."

2.3 PUMP SPECIALTY FITTINGS

- A. Suction Diffuser: Angle pattern, 175-psig pressure rating, ductile-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory-fabricated support.
- B. Triple-Duty Valve: Not Allowed.

PART 3 - EXECUTION

3.1 CONCRETE BASES

- A. Install concrete bases of dimensions indicated for pumps and controllers. Refer to Division 23 Section "Basic Mechanical Materials and Methods."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.2 PUMP INSTALLATION

- A. Comply with HI 14.4 as applicable.
- B. Reduction from line size to horizontal pump connection size shall be made with eccentric reducers attached to the pump with tops flat to allow continuity of flow and to avoid air pockets.
- C. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- D. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- E. Set base-mounted pumps on concrete foundation. Disconnect coupling before setting. Do not reconnect couplings until alignment procedure is complete.
 - 1. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting.
 - 2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

3.3 ALIGNMENT

- A. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.
- B. Comply with pump and coupling manufacturers' written instructions.
- C. Adjust pump and motor shafts for angular and offset alignment.
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Install shut-off, check and throttling valves on discharge side of pumps.
- F. Install Y-type strainer, suction diffuser and shutoff valve on suction side of pumps.
- G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- H. Install pressure gages on pump suction and discharge, at integral pressure-gage tapping, or install single gage with multiple input selector valve.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Check piping connections for tightness.
 - 3. Clean strainers on suction piping.
 - 4. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.
 - 5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
 - 6. Start motor.
 - 7. Open discharge valve slowly.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 23 21 23

SECTION 23 25 00 - HVAC WATER TREATMENT

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 the following HVAC water-treatment systems:

1. Closed system chemical-feed equipment and controls.
2. Open systems chemical-feed equipment and controls.
3. Chemical treatment test equipment.
4. HVAC water-treatment chemicals.
5. Water filtration units for HVAC makeup water.

1.3 DEFINITIONS

- A. Systems:

1. Fluid Cooler condenser water piping (closed system).
2. Fluid Cooler spray water piping system (open system).
3. Geothermal heat pump piping (existing closed system)

1.4 PERFORMANCE REQUIREMENTS

- A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.
- B. HVAC water treatment shall be based on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.
- C. Closed hydronic systems shall have the following water qualities:
 1. pH: Maintain a value within 9.0 to 10.5.
 2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
 3. Microbiological Limits:
 - a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
 - b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/ml.
 - c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.
 - d. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
 - e. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.
- D. Open hydronic systems, shall have the following water qualities:

1. pH: Maintain a value within 8.0 to 9.1.
2. "P" Alkalinity: Maintain a maximum value of 100 ppm.
3. Conductivity: Maintain a value of 2000 megohms.
4. Microbiological Limits:
 - a. Total Aerobic Plate Count: Maintain a maximum value of 10,000 organisms/ml.
 - b. Total Anaerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
 - c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.
 - d. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
 - e. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.

1.5 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:
 1. Bypass feeders.
 2. Water meters.
 3. Inhibitor injection timers.
 4. pH controllers.
 5. Conductivity controllers.
 6. Biocide feeder timers.
 7. Chemical solution tanks.
 8. Injection pumps.
 9. Chemical test equipment.
 10. Bag- or cartridge-type filters.
- B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems.
- C. Wiring Diagrams: Power and control wiring.
- D. Operation and Maintenance Data (Contractor to include in emergency, operation, and maintenance manuals.): For sensors, injection pumps, water filtration units, and controllers
- E. Other Informational Submittals:
 1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements".
 2. Water Analysis: Illustrate water quality available at Project site.
- F. See "Submittal Schedule" located at the end of Section 23 01 00 "General Requirements for Mechanical Systems."

1.6 QUALITY ASSURANCE

- A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 MAINTENANCE SERVICE

- A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for all hydronic systems. Services and chemicals shall be provided for a period of one year from date of Substantial Completion, and shall include the following:
1. Initial water analysis and HVAC water-treatment recommendations.
 2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
 3. Periodic field service and consultation.
 4. Customer report charts and log sheets.
 5. Laboratory technical analysis.
 6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Approved Contractors: Subject to compliance with requirements, Contractors offering services that may be incorporated into the Work include, but are not limited to, the following:
1. Kurita
 2. All manufacturer's below shall be voluntary alternates
 - a. Chem Treat, Inc.
 - b. Rochester Midland
 - c. Water Tech Inc.
 - d. Nalco
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Anderson Chemical Co, Inc.
 2. H-O-H Chemicals, Inc.
 3. Metro Group. Inc. (The); Metropolitan Refining Div.
 4. Nalco Company.
 5. Watcon, Inc.
 6. Chem Treat
 7. Rochester Midland

2.2 CLOSED SYSTEM EQUIPMENT

- A. Glycol Make-up Package: Fully automated and autonomous. Complete with: low level cut-off and alarm arrangement including a 110V signal for remote alarm, isolation valves, strainer, pressure tank with pressure control, pressure reducing valve and gauge, translucent polyethylene solution container with lid designed to accommodate relief valve piping, magnetic starter, 110V, 60Hz motor and controls. All mounted on a sturdy steel frame with 1/2" system connection and factory preset 12psig (field adjustable) discharge

2.3 FLUID COOLER OPEN SYSTEM EQUIPMENT

- A. Conductivity Controller:

1. Microprocessor-based controller, 1 percent accuracy in a range from zero to 5000 micromhos. Incorporate solid-state integrated circuits and digital LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door.
2. Digital display and touch pad for input.
3. Sensor probe adaptable to sample stream manifold.
4. High, low, and normal conductance indication.
5. High or low conductance alarm light, trip points field adjustable; with silence switch.
6. Hand-off-auto switch for solenoid bleed-off valve.
7. Bleed-off valve activated indication.
8. Internal adjustable hysteresis or deadband.
9. Bleed Valves:
 - a. Cooling Systems: Forged-brass body, globe pattern, general-purpose solenoid with continuous-duty coil, or motorized ball valve rated for 600 LB WOG.

2.4 STAINLESS-STEEL PIPES AND FITTINGS

- A. Stainless-Steel Tubing: Comply with ASTM A 269, Type 316.
- B. Stainless-Steel Fittings: Complying with ASTM A 815/A 815M, Type 316, Grade WP-S.
- C. Three-Piece, Full-Port, Stainless-Steel Ball Valves: ASTM A 351, Type 316 stainless-steel body; ASTM A 276, Type 316 stainless-steel stem and vented ball, threaded body design with adjustable stem packing, threaded ends, and 600-psig CWP rating.

2.5 CHEMICAL TREATMENT TEST EQUIPMENT

- A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, conductivity, inhibitor, alkalinity, hardness, and for oxidizing biocide test for open cooling systems.
- B. Corrosion Test-Coupon Assembly: Constructed of corrosive-resistant material, complete with piping, valves, and mild steel and copper coupons. Locate copper coupon downstream from mild steel coupon in the test-coupon assembly.
 1. Two station rack for closed-loop systems.
 2. None required for fluid cooler open system.

2.6 CHEMICALS

- A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

- A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

- A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.
- B. Install water testing equipment on wall near water chemical application equipment.
- C. Install interconnecting control wiring for chemical treatment controls and sensors.
- D. Mount sensors and injectors in piping circuits.
- E. Closed system feeders: Install in all closed hydronic systems, with the following:
 - 1. Install bypass feeder in a bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
 - 2. Install water meter in makeup water supply.
 - 3. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
 - 4. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.
 - 5. Install a swing check on inlet after the isolation valve.
- F. Install open system automatic chemical-feed equipment and include the following:
 - 1. Install water meter in makeup water supply.
 - 2. Install inhibitor injection pumps and solution tanks with injection timer sensing contacts in water meter.
 - a. Pumps shall operate for timed interval on contact closure at water meter in makeup water supply connection.
 - 3. Install test equipment and provide test-kit to Owner. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
 - 4. Install conductivity controller with sensor and bleed valves.
 - a. Bleed valves shall cycle to maintain maximum TDS concentration.
 - 5. Install pH sensor and controller with injection pumps and solution tanks.
 - a. Injector pumps shall operate to maintain required pH.
 - 6. Install biocide feeder alternating timer with two sets of injection pumps and solution tanks.
 - a. Injection pumps shall operate to feed biocide on an alternating basis.

3.3 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 equipment to allow service and maintenance.
- C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Division 23 Section "Basic Mechanical Materials and Methods."

- D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Division 23 Section "Valves for HVAC."
- E. Refer to Division 22 Section "Plumbing Specialties" for backflow preventers required in makeup water connections to potable-water systems.
- F. Confirm applicable electrical requirements in Division 26 Sections for connecting electrical equipment.
- G. Ground equipment according to Division 26.
- H. Connect wiring according to Division 26.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
 - 2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
 - 3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
 - 4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
 - 5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
 - 7. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
 - 8. Repair leaks and defects with new materials and retest piping until no leaks exist.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. At six week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article.
- F. Comply with ASTM D 3370 and with the following standards:
 - 1. Silica: ASTM D 859.
 - 2. Steam System: ASTM D 1066.
 - 3. Acidity and Alkalinity: ASTM D 1067.
 - 4. Iron: ASTM D 1068.
 - 5. Water Hardness: ASTM D 1126.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment

END OF SECTION 23 25 00

SECTION 23 57 00 - HEAT EXCHANGERS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Gasketed-plate heat exchangers.
- B. The Owner will select and employ the Commissioning Authority (CxA) for this project. All Contractors shall cooperate with the CxA to complete all required commissioning. Specification Section 23 08 00 defines the Contractor's responsibilities with respect to the process. The Contractor shall review this section and shall include in their bids the work associated with the commissioning effort described.

1.3 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
- B. See Submittal Schedule located at the end of Section 23 01 00 "General Requirements for Mechanical Systems."

1.4 INFORMATIONAL SUBMITTALS

- A. Source quality-control reports.
- B. Field quality-control reports.
- C. Sample Warranty: For manufacturer's warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For heat exchangers to include in emergency, operation, and maintenance manuals.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of heat exchangers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including heat exchanger, storage tank, and supports.

- b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
- 2. Warranty Periods: From date of Substantial Completion.
 - a. Plate Heat Exchangers:
 - 1) Gasketed-Plate Type; One year(s).

PART 2 - PRODUCTS

2.1 GASKETED-PLATE HEAT EXCHANGERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alfa Laval Inc.
 - 2. Armstrong Fluid Technology.
 - 3. Bell & Gossett; a Xylem brand.
 - 4. Spirax Sarco Limited.
 - 5. Taco Comfort Solutions.
- B. Configuration: Freestanding assembly, consisting of frame support, top and bottom carrying and guide bars, fixed and movable end plates, tie rods, individually removable plates, and one-piece gaskets. Floor-mounted heat exchangers must have integral legs with mounting feet.
- C. Construction: Fabricate and label heat exchangers to comply with ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Division 1.
- D. Frame:
 - 1. Capacity to accommodate 20 percent additional plates.
 - 2. Painted carbon steel with provisions for anchoring to support.
- E. Top and Bottom Carrying and Guide Bars: Painted carbon steel, aluminum, or stainless steel.
- F. End-Plate Material: Painted carbon steel.
- G. Tie Rods and Nuts: Steel or stainless steel.
- H. Plate Material: 0.024 inch thick before stamping; Type 304 stainless steel.
- I. Gasket Materials: Glue free Nitrile rubber.
- J. Piping Connections: Factory fabricated of materials compatible with heat-exchanger shell. Attach tappings to shell before testing and labeling.
 - 1. Flanged ends in accordance with ASME B16.5 for steel and stainless steel flanges and in accordance with ASME B16.24 for copper and copper-alloy flanges.
- K. Enclose plates in solid aluminum removable shroud.

2.2 ACCESSORIES

- A. Hangers and Supports:
 - 1. Steel supports and saddles for mounting on floor.
- B. Shroud: Steel sheet.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect heat exchangers in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Division 1. Affix ASME International label.
- B. Hydrostatically test heat exchangers to minimum of one and one-half times pressure rating before shipment.
- C. Heat exchangers will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas for compliance with requirements for installation tolerances and for structural rigidity, strength, anchors, and other conditions affecting performance of heat exchangers.
- B. Examine roughing-in for heat-exchanger piping to verify actual locations of piping connections before equipment installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF HEAT EXCHANGER, GENERAL

- A. Equipment Mounting:
 - 1. Install floor-mounted heat exchangers on cast-in-place concrete equipment bases. Install all heat exchangers level and plumb in accordance with manufacturer's recommendations. Install floor-mounted and wall-hung steam heat exchangers at sufficient height, using sufficient length supports, to achieve required steam and condensate pipe pitch. Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."

3.3 INSTALLATION OF GASKETED-PLATE HEAT EXCHANGER

- A. Install floor-mounted gasketed-plate heat exchangers on cast-in-place concrete equipment base, and fasten legs to base.
- B. Install metal shroud over installed gasketed-plate heat exchanger in accordance with manufacturer's written instructions.

3.4 PIPING CONNECTIONS

- A. Comply with requirements for piping specified Section 23 21 13 "Hydronic Piping". Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Maintain manufacturer's recommended clearances for plate removal, service, and maintenance.
- C. Install piping adjacent to heat exchangers to allow space for service and maintenance of heat exchangers. Arrange piping for easy removal of heat exchangers.
- D. Install shutoff valves at heat-exchanger inlet and outlet connections.
- E. Install pressure-relief valves on heat-exchanger tube outlet piping before any isolation valves.
- F. Install hose end valve to drain shell.
- G. Install thermometer on each heat-exchanger fluid inlet and outlet piping.
- H. Install pressure gauges on each heat-exchanger fluid inlet and outlet piping.

3.5 CLEANING

- A. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.
- B. Isolate heat exchangers from piping before flushing piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blind flanges in flanged joints to isolate equipment.
- C. Flush heat-exchanger piping systems with clean water; then remove and clean or replace strainer screens before reopening flow to heat exchangers.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency, Owner: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency, Contractor: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.
- E. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Heat exchanger will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain heat exchangers.

END OF SECTION 23 57 00

SECTION 23 65 00 - CLOSED-CIRCUIT, INDUCED-DRAFT, COUNTERFLOW COOLING TOWERS

PART 1 - GENERAL

1.1 Part of owner furnished equipment package. Included for reference only.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Owner will select and employ the Commissioning Authority (CxA) for this project. All Contractors shall cooperate with the CxA to complete all required commissioning. Specification Section 01 91 13 defines the Contractor's responsibilities with respect to the process. The Contractor shall review this section and shall include in their bids the work associated with the commissioning effort described.

1.3 SUMMARY

- A. Section includes factory-assembled, closed-circuit, induced-draft, counterflow cooling towers.

1.4 DEFINITIONS

- A. SCCR: Short-circuit current rating.

1.5 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, pressure drop, fan performance data, rating at selected points indicated, and furnished specialties and accessories.
 - 2. Maximum flow rate.
 - 3. Minimum flow rate.
 - 4. Pressure required at cooling tower supply piping connections.
 - 5. Drift loss as percent of design flow rate.
 - 6. Sound:
 - a. Sound pressure levels for operation with fan off, fan at minimum speed, and design speed. If sound requirements are indicated at a specific distance, submit performance using same distance for comparative analysis.
 - b. Sound power levels in eight octave bands for operation with fans off, fans at minimum speed, and design speed.
 - 7. Fan airflow at design conditions, brake horsepower, and drive losses (indicated in horsepower and percent of brake horsepower).
 - 8. Fan motor electrical characteristics including, but not limited to, speed, voltage, phase, hertz, amperage, efficiency, and power factor at 100, 75, 50, and 25 percent of nameplate horsepower.
 - 9. Pump flow rate, head, brake horsepower, and efficiency.

10. Pump motor electrical characteristics including, but not limited to, speed, voltage, phase hertz, amperage, efficiency, and power factor at 100, 75, 50, and 25 percent of nameplate horsepower.
 11. Electrical power requirements for each cooling tower component requiring power.
- B. Shop Drawings:
1. Manufacturer's drawings of assembled cooling towers, control panels, sections, and elevations.
 2. Assembled unit dimensions.
 3. Diagram showing each separate piece requiring field assembly.
 4. Shipped sub-assembly dimensions and weights for field assembly.
 5. Assembled unit weight without water.
 6. Operating weight and load distribution.
 7. Unit vibration isolation.
 8. Required clearances for maintenance and operation.
 9. Sizes and dimensioned locations of piping and wiring connections.
 10. Diagrams for power, signal, and control wiring.
- C. Coordination Drawings:
1. Drawings on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - a. Structural supports.
 - b. Piping roughing-in requirements.
 - c. Conduit and wiring roughing-in requirements for controls and electrical power, including spaces reserved for controls and electrical equipment.
 - d. Access requirements, including working clearances for controls and electrical equipment, and service clearances. Mark and label clearances.
 2. Drawings showing plans, sections, and elevation views, drawn to scale of at least $\frac{1}{4}" = 1'-0"$.
 3. Each view to show screened background with the following:
 - a. Structural grids.
 - b. Adjacent walls, floors, and roofs.
 - c. Equipment and products of other trades that are located in vicinity of cooling towers and are part of final installation, such as controls, power, lighting, fire-suppression systems, and plumbing systems.
- D. Product Certificates: For certification required in "Quality Assurance" Article.
- E. Field Test Reports: Include startup service reports.
- F. Source quality-control reports.
- G. Field quality-control reports.
- H. Sample Warranty: For special warranty.
- I. Operation and Maintenance Data: For each cooling tower to include in emergency, operation, and maintenance manuals.
- J. Belts:
1. Furnish one set of matching belts for each unique belt configuration and size furnished.
- K. Tool Kit:

1. A tool kit specially designed by cooling tower manufacturer for use in servicing cooling tower furnished.
 2. Special tools required to service components not readily available to Owner service personnel in performing routine maintenance.
 3. Lockable case with hinged cover, marked with large and permanent text to indicate the special purpose of tool kit, such as "Fluid Cooler Tool Kit." Text size shall be at least 1 inch high.
 4. A list of each tool furnished. Permanently attach the list to underside of case cover. Text size shall be at least 1/2 inch high.
- L. Touchup Coating: 32-oz. container of paint coating used. Label outside of container with detailed description of coating to allow for procurement of a matching coating in the future.

1.6 QUALITY ASSURANCE

- A. ASME Compliance: Fabricate and label heat-exchanger coils to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- B. CTI Certification: Cooling tower thermal performance according to CTI STD 201RS.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Coordinate requirements for multi-piece assembly for shipment. Limit the number of separate pieces for field installation to as few as possible.
- B. If factory assembly of multiple pieces is required for testing or other reasons, disassemble cooling tower into major assemblies as required by installation before packaging for shipment.
1. Clearly label each separate package with a unique designation and include with assembly instructions for each complete cooling tower.
 2. Install seals on gear-drive assemblies to eliminate oil leakage during shipment if shipped with oil.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace the following components of cooling towers that fail in materials or workmanship within specified warranty period:
1. Fan Motor/Drive System: Warranty Period shall be Five (5) years from date of unit shipment from Factory (fan motor(s), fan(s), bearings, mechanical support, sheaves, bushings and belt(s)).
 2. The Entire Unit shall have a comprehensive one (1) year warranty against defects in materials and workmanship from startup, not to exceed eighteen (18) months from shipment of the unit.
 3. Heat Transfer Coil: Warranty Period shall be One (1) year from date of unit shipment from Factory.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. 1 extra set of belts for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Baltimore Aircoil Company.
2. EVAPCO, Inc.
3. SPX Cooling Technology
4. Approved Substitute

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Cooling tower and support structure shall withstand the effects of loads and stresses within limits and under conditions indicated according to governing code.
- B. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Vibration:
1. Rotating assemblies shall be dynamically balanced to achieve a balance level of "good" while complying with industry standard requirements for cooling towers.
 2. Critical speed shall be at least 115 percent of design speed.

2.3 DESIGN ARRANGEMENT

- A. Counterflow design with airflow from all sides and induced-draft, top-mounted axial fan and pressurized pipe distribution.

2.4 CASING AND FRAME

- A. Casing Material: Galvanized steel, ASTM A653/A653M, G235 coating.
- B. Frame Material: Galvanized steel, ASTM A653/A653M, G235 coating.
- C. Hardware: Galvanized steel.
- D. Joints and Seams: Sealed watertight.
- E. Welded Connections: Sealed watertight by continuous welds.

2.5 COLLECTION BASIN

- A. Factory-Assembled Collection Basin:
1. Material: Stainless steel, Grade 304.
 2. Hardware: Stainless steel.

3. Joints and Seams: Sealed watertight.
4. Welded Connections: Sealed watertight by continuous welds.
5. Removable stainless-steel strainer with openings smaller than nozzle orifices.
6. Overflow and drain connections.
7. Makeup-water connection.
8. Outlet Connection: Configured to mate to ASME B16.5, Class 150 flange.
9. Water Silencer: The unit shall be provided with water silencers located in the falling water area of the cold-water basin. The water silencers shall be constructed of lightweight PVC in easily handled sections for ease of removal and access to the basin area.

2.6 COLLECTION BASIN MAKEUP-WATER ASSEMBLY

- A. Make up float assembly shall be a mechanical brass valve with an adjustable plastic float.

2.7 PRESSURIZED DISTRIBUTION NETWORK

- A. Main header and lateral branch piping designed for even distribution over heat-exchanger coils throughout the entire flow range without the need for balancing valves and for connecting individual, easily removable, nonclogging spray nozzles.
- B. Pipe Material: Schedule 40 PVC.
- C. Spray Nozzle Material: ABS Plastic or PVC.
- D. Piping Supports: Corrosion-resistant hangers and supports to resist movement during operation and shipment.

2.8 HEAT-EXCHANGER COILS

- A. Tube and Tube Sheet Materials: Carbon-steel tube and sheet with outer surface of tube and sheet hot-dip galvanized after fabrication.
- B. Heat-Exchanger Arrangement:
 1. Serpentine tubes; sloped for complete drainage of fluid by gravity.
 2. Tubes with extended surface fins if required to achieve performance indicated.
- C. ASME Compliance: Designed, manufactured, and tested according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, and bearing ASME "U" stamp; sloped for complete drainage of fluid by gravity.
- D. Field Piping Connections: Vent, supply, and return suitable for mating to ASME B16.5, Class 150 flange.

2.9 DRIFT ELIMINATORS

- A. Material: PVC; with maximum flame-spread index of 5 according to ASTM E84.
- B. UV Treatment: Inhibitors to protect against damage caused by UV radiation.
- C. Arrangement: Multiple, easily removable sections.
- D. Configuration: Multipass, designed and tested to reduce water carryover to 0.001 percent of design flow rate indicated.

- E. Hardware: Galvanized steel.

2.10 AIR INLET

- A. Air-Intake Louvers:

1. Material: PVC.
2. UV Treatment: Inhibitors to protect against damage caused by UV radiation.
3. Multiple, easily removable sections arranged to uniformly direct air into cooling tower, to minimize air resistance, to block direct sunlight, and to prevent water from splashing out of tower during all modes of operation including operation with fans off.

- B. Hardware: Galvanized steel.

2.11 FAN AND DRIVE ASSEMBLY

- A. Axial Fan: Balanced at the factory after assembly.

1. Fan shall be low sound design with wide chord blades.
2. Blade Material: Aluminum.
3. Hub Material: Aluminum.
4. Fan Shaft: Corrosion resistant.
5. Fan Shaft Bearings: Self-aligning ball or roller bearings with moisture-proof seals and premium, moisture-resistant grease suitable for temperatures between minus 20 and plus 300 deg F. Bearings designed for an L-10 life of 80,000 hours.
6. Bearings Grease Fittings: Extended lubrication lines to an easily accessible location.
7. Automatic Bearing Greasing System:
 - a. Manufacturer designed system to provide an as needed supply of new grease to bearings while reducing the need for periodic bearing maintenance and associated greasing problems.
 - b. Easily replaceable storage container filled with recommended grease and located in an easily accessible location on cooling tower exterior. Container capacity of sufficient size to provide grease for one year.

- B. Belt Drive:

1. Service Factor: 1.5 based on motor nameplate horsepower.
2. Sheaves: Fan and motor shafts shall have taper-lock sheaves fabricated from corrosion-resistant materials.
3. Belt: Multiple V-belt design with a matched set of cogged belts.
4. Belt Material: Oil resistant, nonstatic conducting, and constructed of neoprene polyester cord.
5. Belt-Drive Guard: Comply with OSHA regulations.

- C. Fan Motor:

1. Comply with NEMA MG 1 unless otherwise indicated.
2. Description: NEMA MG 1, Design B, as required to comply with capacity and torque characteristics; medium induction motor.
3. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
4. Motor Enclosure: Totally enclosed, totally enclosed air-over (TEAO) or totally enclosed fan-cooled (TEFC).
5. Rotor: Random-wound, squirrel cage.
6. Energy Efficiency: Comply with ASHRAE/IES 90.1.

7. Service Factor: 1.15.
8. Temperature Rise: Match insulation rating.
9. Insulation: Class F.
10. Variable-Speed Motors: Inverter-duty rated per NEMA MG 1, Section IV, "Performance Standard Applying to All Machines," Part 31, "Definite-Purpose, Inverter-Fed, Polyphase Motors."
11. Motor Base: Adjustable, or other suitable provision for adjusting belt tension.
12. Motor Shaft Grounding: Motors shall be controlled through variable-frequency controllers with shaft grounding system to protect motor bearings from induced voltage. Drag on motor shaft due to shaft ground system shall be less than 0.5 percent of motor nameplate horsepower.

D. Hardware: Galvanized steel.

2.12 AIR DISCHARGE

A. Fan Discharge Stack:

1. Manufacturer's standard low-profile design.
2. Material: Material to match casing.
3. Stack Termination: Wire-mesh, galvanized-steel screens; segmented into multiple removable pie sections and complying with OSHA regulations.

2.13 RECIRCULATING WATER DISTRIBUTION SYSTEM

A. Pump: Close-coupled, single-stage, bronze-fitted centrifugal pump; with mechanical seal and suitable for outdoor service. Factory install pump with following:

1. Flanges at pump connections to piping.
2. Strainer, with blowdown isolation valve, installed in piping on suction side of pump.
3. Flow balancing valve in piping on discharge side of pump.

B. Pump Motor:

1. Comply with NEMA MG 1 unless otherwise indicated.
2. Description: NEMA MG 1, Design B, as required to comply with capacity and torque characteristics; medium induction motor.
3. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
4. Motor Enclosure: Totally enclosed.
5. Rotor: Random-wound, squirrel cage.
6. Energy Efficiency: Comply with ASHRAE/IES 90.1.
7. Service Factor: 1.15.
8. Temperature Rise: Match insulation rating.
9. Insulation: Class F.

C. Piping: Interconnecting collection basin to pump and pressurization distribution system.

1. Design delegated to manufacturer.
2. External to and supported from cooling tower casing and frame.
3. Material: PVC.
4. Install flanges at connections to collection basin and pressurized distribution system.
5. Drain connection with isolation valve at piping low point if piping does not drain directly into collection basin.

2.14 CONTROLS

- A. Vibration Switch: For each fan drive.
 - 1. Enclosure: NEMA 250, Type 4.
 - 2. Vibration Detection: Sensor with a field-adjustable, acceleration-sensitivity set point in a range of 0 to 1 g and frequency range of 0 to 3000 cycles per minute. Cooling tower manufacturer shall recommend switch set point for proper operation and protection.
 - 3. Switch shall have manual-reset button hardwired connection to fan motor electrical circuit.
 - 4. Switch shall have field connection to a control system hardwired connection to fan motor electrical circuit.
 - 5. Switch shall, on sensing excessive vibration, signal an alarm for connection to control system and shut down the fan.
- B. Comply with requirements on plans and in Section 23 09 93.

2.15 SERVICE ACCESS

- A. Doors:
 - 1. Large enough for personnel to access cooling tower internal components.
 - 2. Doors shall be hinged with handles operable from both sides of the door.
 - 3. Door materials shall match casing.
 - 4. Hinges and handles shall be corrosion resistant.
- B. External Platforms with Handrails: Galvanized-steel bar grating at cooling tower access doors when cooling towers are elevated and not accessible from grade.
- C. Fan Deck Floor between Cooling Tower Cells:
 - 1. Factory furnish reinforced fan deck floor panels between cooling tower cells for field installation.
 - 2. Floor materials shall match adjacent cooling tower cell fan deck.
 - 3. Fan deck floor shall fasten to and be supported by framing that is attached to cooling tower cells.
 - 4. Frame shall be constructed of same materials as cooling tower frame.
- D. Handrail: Galvanized steel complete with kneerail and toeboard, around external platforms and top of cooling tower. Comply with 29 CFR 1910.23.
- E. Platforms: Galvanized-steel bar grating.
 - 1. Spanning the collection basin from one end of cooling tower to the other and positioned to form a path between. Platform shall be elevated so that all parts are above the high water level of the collection basin.
 - 2. Elevated internal platforms with handrails accessible from fixed vertical ladders to access the fan drive assembly when out of reach.
- F. Hardware: Galvanized steel when connecting galvanized-steel components; stainless steel when connecting other materials.

2.16 EVAPORATIVE COOLING WATER TREATMENT SYSTEM

- A. GENERAL
 - 1. DESCRIPTION

a. Work Includes:

- 1) Furnish all labor, materials, tools, equipment and services for condenser water treatment system as indicated, in accordance with provisions of the contract documents.
- 2) Completely coordinate with work of all other trades.
- 3) See Division 1 for General Requirements.
- 4) Manufacturer's representative company will provide automatically controlled water treatment program and equipment as specified herein.
- 5) Provide monthly service for the condenser water treatment program, including the necessary chemicals designed to minimize corrosion, scale formation and biological growth in the following mechanical systems:

a) Condenser Water Piping System

b. Description of System:

- 1) Riser mounted solid-chemistry inhibitor feeder by equipment manufacturer.
- 2) Unit mounted bio-control feeder(s) (by equipment manufacturer) capable of feeding granular biocide without supplemental make-down water.
- 3) Solid, controlled release chemicals as specified below.
- 4) Factory mounted (by equipment manufacturer) conductivity controller and bleed valve as specified below. System shall be self-draining.

2. SUBMITTALS

a. Shop drawings: Show all water treatment equipment, including the following:

- 1) Piping diagrams of all factory mounted components (show all field piping required, if any).
- 2) Conductivity control panel and wiring diagrams (show all field wiring required). Include bill of materials showing model number, manufacturer, physical layout drawings, panel and equipment catalog cuts.

b. Operation and maintenance manuals: Include testing procedures for each of the treated systems.

c. List of chemicals and methods to be used for each system: Use generic names. Provide Material Safety Data Sheets (MSDS) for each chemical used.

d. Laboratory analysis of project site make-up water: Submit a copy of a laboratory analysis documenting the quality of the project's make-up water. Make-up water analysis to include the following analytes as a minimum:

- 1) Calcium Hardness (as ppm CaCO_3)
- 2) Total Hardness (as ppm CaCO_3)
- 3) Total Alkalinity or m-Alkalinity (as ppm CaCO_3)
- 4) pH
- 5) Silica (as SiO_2)
- 6) Specific Conductivity (micro S/cm)
- 7) Sulfate (as SO_4)
- 8) Chloride (as Cl^-)
- 9) Phosphate (as PO_4)

3. QUALITY ASSURANCE

a. The water treatment supplier shall:

- 1) Obtain water samples from the site and furnish a laboratory analysis of the water supply with submittal.

- 2) Review the make-up water analysis to ensure compatibility with the water treatment program.
 - 3) Propose water treatment methods and appropriate chemicals required to minimize scale, corrosion and biological growth. Submit all of the above with shop drawings and other required submittals.
- b. Methods and chemicals selected shall comply with all the requirements of the American Public Health Association (APHA), the Environmental Protection Agency (EPA) and local environmental agencies.
4. PERFORMANCE CRITERIA
- a. Maintain the conditions listed below in the water system(s):
- 1) Conductivity range of 300 to 5,000 micro S/cm.
 - 2) pH range of 7.0 to 8.8
 - 3) Local environmental regulations may dictate the highest pH permitted for blowdown. The conductivity setting can be adjusted up or down to change the pH by the balancing of fresh make-up water.
 - 4) Total bacteria count (TBC) of less than 10,000 CFU/ml.
 - 5) Keep condenser water system scale free and corrosion to levels acceptable by AWT guidelines.

B. PRODUCTS

1. WATER TREATMENT SYSTEM

- a. Acceptable Products:
- 1) Chemical Feed & Control Equipment
 - a) Factory mounted inhibitor feeder
 - b) Factory mounted biocide feeder
 - c) Factory mounted conductivity controller, piping manifold with conductivity probe and sampling port
- b. Chemicals
- 1) Chromates, zinc, or any liquid chemicals shall not be used.
 - 2) Scale and corrosion inhibitor shall be non-toxic to humans and animals for its intended use. Phosphates are allowed as permitted by EPA and local authorities. Scale and corrosion inhibitor chemistry shall be provided in a solid form with controlled released polymer coating for safe handling and easy reloading.
 - 3) The chemical feed equipment shall operate and feed chemicals into the condenser water system only when the systems recirculating pumps are in operation.
 - 4) The granular biocide shall be packaged such that handling of the chemistry directly is minimized.
- c. Condenser Water System:
- 1) Chemical feed and control equipment - condenser system: Provide the following components (including all factory piping and wiring).
- d. Factory mounted assembly for controlling conductivity and providing automatic solid chemical treatment to the condenser water system(s). The assembly system shall have the following features and capabilities:

Conductivity controller: Shall provide linear, temperature compensated measurements directly in micromhos over full range. Conductivity measurement will be displayed on an LED display. Controller will have a USB port and shall be capable of retrieving operational frequency of bleed valve, output contact, make-up/bleed metering over a 60 day period.

- 1) Inhibitor feed: Inhibitor chemical shall be fed directly from the unit riser pipe. A solid chemistry inhibitor shall be used with time released control mechanism. No pumps, timers or liquids shall be accepted.
 - 2) Biocide feed: Biocide chemical feeds will be controlled by a factory mounted feeder. Solid biocide will be fed directly into the recirculating stream. No pumps, timers or liquids shall be accepted.
 - 3) Basis of design - EVAPCO Smart Shield®
- e. The conductivity controller, chemical feeders and sample stream piping assembly shall be factory mounted on the closed circuit cooler or evaporative condenser. All components of the system shall be pre-plumbed and pre-wired to minimize field connections required to provide an operational treatment system. The packaged system shall consist of the following:
- 1) One (1) sample stream piping assembly consisting of:
 - a) Two (2) 1 inch inlet/outlet shut-off valves.
 - b) One (1) conductivity probe of PVC construction, with a temperature compensating torodial probe mounted in the sample stream.
 - 2) One (1) pre-piped bleed-off piping assembly consisting of inlet shut-off valve, sample valve, throttling valve and motorized ball valve. Bleed-off piping assembly shall be sized to provide the proper bleed-off rate of the system. Bleed piping and controller should prevent the feed of biocide during the bleed cycle.
 - 3) Factory mounted solid chemical inhibitor feeder(s) shall be provided for feed of the scale and corrosion inhibitor. Feed rate shall be adjustable based on a multiple chamber feeder arrangement.
 - 4) Factory mounted solid biocide chemical feeder(s) shall be provided for feed of the biocide. Feeder shall be completely factory mounted for easy commissioning and refill.
 - 5) Water treatment chemicals: Calculate and furnish 1-year supply of the recommended product for control of scale and corrosion in the open recirculating system. Additionally, calculate and furnish a 1- year supply of biocide for control of microbiological growth in the same system. The one year supply of chemistry shall be calculated based on the most efficient cycles of concentration the make-up water quality will allow. Biocide product recommended shall be properly registered with the Environmental Protection Agency and EPA registration number shall be clearly shown on all product literature and package labels. To ensure operator safety, all chemical products shall be provided in solid or granular form for reduced material handling.
- f. Testing equipment: Provide water test kits and equipment necessary to control the condenser water systems treatment program. Test kits to include the following as a minimum:
- 1) Reagents and apparatus for determination of corrosion inhibitor level in the condenser water systems.
 - 2) Reagents and apparatus for determination of pH, total alkalinity, free and total chlorine, and calcium hardness.
 - 3) Apparatus for determination of microbiological colony population and biocide effectiveness.

C. EXECUTION

1. INSTALLATION AND SERVICES

- a. Installation of water system will include:
 - 1) All components shall be mounted by the evaporative equipment manufacturer during unit construction and prior to shipment from the factory.
 - 2) Supply all components (coils, transformers, conductivity meters, blow down valves etc) necessary for a completely automated stand-alone system. Blow down valves shall be motorized ball valves power open, spring return factory mounted during unit construction.
 - 3) Immediately after hydrostatic testing of piping is completed the mechanical contractor shall drain, flush, clean and passivate all systems. Subsequent to the cleaning process, each system shall be re-filled with clean water prior to the system being placed into operation. Once filled the condenser water pump and cooling tower fans shall be operated until conductivity set point is achieved.
 - 4) Mechanical contractor shall pipe all bleed and drain lines to sanitary sewer.
 - 5) If the working height of the water treatment system will be elevated, there shall be a safe way to service the system provided.
- b. Provide all consulting services, for a period of 1-year from start-up of the cooling system, which will include:
 - 1) Installation and system start-up procedure recommendations.
 - 2) Pre-operation system clean-out procedure supervision.
 - 3) Initial water analysis and recommendations.
 - 4) Training of operating personnel on proper feeding and control techniques.
 - 5) Monthly field service visits during wet operation.
 - 6) Any necessary log sheets and record forms.
- c. All services will be provided by a factory authorized service provider of the evaporative condenser or closed circuit cooler manufacturer.

2.17 SOURCE QUALITY CONTROL

- A. Performance Test: Factory test and certify cooling tower performance according to CTI STD 201RS, "Standard for the Certification of Water-Cooling Tower Thermal Performance."
 - 1. Prepare test report indicating test procedures, instrumentation, test conditions, and results. Submit copy of results within one week of test date.
- B. Factory Functional Tests:
 - 1. Test collection and distribution basins after assembly, and prove free of leaks.
 - 2. Test factory-installed electric/electronic water-level controls for proper operation.
 - 3. Test factory-installed electric basin heaters for proper operation.
 - 4. Test factory-installed fan and drive assemblies for proper operation.
 - 5. Test factory-installed control package for proper operation.
 - 6. Test access doors to ensure smooth operation and proper fit.
 - 7. Submit report documenting tests performed and results within one week of test date.
- C. Heat-Exchanger Factory Pressure and Leak Tests:
 - 1. Pneumatically test heat-exchanger assembly while submerged underwater and prove to be free of leaks.
 - 2. Test pressure equal to 1.5 times rated pressured, but not less than 375 psig.
 - 3. Submit report documenting test and results.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine cooling towers before installation. Reject cooling towers that are damaged.
- B. Before cooling tower installation, examine roughing-in for tower support, anchor-bolt sizes and locations, piping, controls, and electrical connections to verify actual locations, sizes, and other conditions affecting cooling tower performance, maintenance, and operation.
 - 1. Cooling tower locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping, controls, and electrical connections.
 - 2. Verify sizes and locations of concrete bases and support structure with actual equipment.
 - 3. Verify sizes, locations, and anchoring attachments of structural-steel support structures.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install cooling towers on structural rails. See structural plans for details.
- B. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Maintain manufacturer's recommended clearances for service and maintenance.
- D. Maintain clearances required by governing code.
- E. Loose Components: Install components, devices, and accessories furnished by manufacturer with cooling tower, that are not factory mounted.
 - 1. Loose components shall be installed by manufacturer's factory-trained service personnel.

3.3 PIPING CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to cooling towers, allow space for service and maintenance.
- C. Install drain piping with valve at cooling tower drain connections and at low points in piping.
- D. Connect cooling tower overflows and drains, and piping drains to sanitary sewage system.
- E. Makeup-Water Piping:
 - 1. Comply with applicable requirements in Section 22 11 16 "Domestic Water Piping."
 - 2. Connect to makeup-water connections with shutoff valve, plugged tee with pressure gage, and drain connection with valve and union.
- F. Supply and Return Piping:
 - 1. Comply with applicable requirements in Section 23 21 13 "Hydronic Piping."

2. Connect to entering cooling tower connections with shutoff valve, strainer, balancing valve, thermometer, plugged tee with pressure gage, and drain connection with valve.
3. Connect to leaving cooling tower connection with shutoff valve thermometer, plugged tee with full port ball valve for portable field instruments, and drain connection with valve.
4. Make connections to cooling tower with a flange.

3.4 ELECTRICAL POWER CONNECTIONS

- A. Connect field electrical power source to each separate electrical device requiring field electrical power. Coordinate termination point and connection type with Installer.
- B. Comply with requirements in Division 26.
- C. Comply with requirements in Division 26.
- D. Install nameplate for each electrical connection indicating electrical equipment designation and circuit number feeding connection. Nameplate shall be laminated phenolic layers of black with engraved white letters at least 1/2 inch high. Locate nameplate where easily visible.

3.5 CONTROLS CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring between cooling towers and other equipment to interlock operation as required to achieve a complete and functioning system.
- C. Connect control wiring between cooling tower control interface and DDC system for remote monitoring and control of cooling towers. Comply with requirements in Section 23 09 00 and 230933.
- D. Install label at each termination indicating control equipment designation serving cooling tower and the I/O point designation for each control connection. Comply with requirements in Division 26 for labeling and identification products and installations.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections: Comply with ASME PTC 23 or CTI ATC 105.
- C. Cooling towers will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.7 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Inspect field-assembled components, equipment installation, and piping; controls; and electrical connections for proper assemblies, installations, and connections.

C. Obtain performance data from manufacturer.

1. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
 - a. Clean entire unit including basins.
 - b. Verify that accessories are properly installed.
 - c. Verify clearances for airflow and for cooling tower servicing.
 - d. Check for vibration isolation and structural support.
 - e. Lubricate bearings.
 - f. Verify fan rotation for correct direction and for vibration or binding and correct problems.
 - g. Verify pump rotation for correct direction, vibration, cavitation, and flow and correct problems.
 - h. Adjust belts to proper alignment and tension.
 - i. Operate variable-speed fans through entire operating range and check for harmonic vibration imbalance. Set motor controller to skip speeds resulting in abnormal vibration.
 - j. Check vibration switch setting. Verify operation.
 - k. Verify water level in tower basin. Fill to proper startup level. Check makeup-water-level control and valve.
 - l. Verify operation of basin heater and control.
 - m. Verify that cooling tower air discharge is not recirculating air into tower or HVAC air intakes. Recommend corrective action.
 - n. Replace defective and malfunctioning units.

D. Start cooling tower and associated water pumps. Follow manufacturer's written starting procedures.

E. Prepare a written startup report that records the results of tests and inspections.

3.8 ADJUSTING

- A. Set and balance water flow to each tower inlet.
- B. Adjust water-level control for proper operating level.
- C. Adjust basin heater control for proper operating set point.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cooling towers.
 1. Video record the training sessions.
 2. Instructor shall be factory trained and certified.
 3. Perform not less than 4 hours of training.
 4. Train personnel in operation and maintenance and to obtain maximum efficiency in plant operation.
 5. Perform instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
 6. Obtain Owner sign-off that training is complete.
 7. Owner training shall be held at Project site.

END OF SECTION 23 65 00

SECTION 26 01 00 – GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.
- B. The Owner has contracted directly with the Commissioning Authority (CxA) for this project. Primary CxA is Name and Contact Info. All Contractors shall cooperate with the CxA to complete commissioning activities. Refer to Commissioning Specification Section 01 91 13 and other referenced Commissioning specification sections for the Contractor's responsibilities. All Contractors shall review this section and include in their bids the work associated with the commissioning effort as described.

1.2 SUMMARY

- A. This Section includes general electrical requirements and shall apply to all phases of the work specified, indicated on the drawings or required to provide for complete installation of electrical systems.

1.3 WARRANTIES

- A. All materials, workmanship and equipment shall be warranted against defects or against injury from proper and usual wear for a period of one year after the date of substantial completion. Certain equipment shall be warranted beginning at the time of final acceptance or for longer periods of time as specified in those sections of the Project Manual. Any item which becomes defective within the warranty period shall be repaired or replaced, at no additional cost to the Owner.
- B. All manufactures warranties shall run to the benefit of the Owner. No manufacturer's warranties shall be voided or impaired.
- C. Warranty shall include repair of faulty workmanship.

1.4 ALTERNATES

- A. Alternates, if required, shall be as described in the "Alternates" section of this specification, as described on the proposal form or as indicated on the drawings.

1.5 INTERPRETATION OF DOCUMENTS

- A. Any questions regarding the meaning of any portion of the contract documents shall be submitted to the Architect/Engineer for interpretation. Addenda or supplemental information will publish definitive interpretations or clarification. Verbal interpretation not issued by addendum or supplemental information shall not be considered part of the contract documents.
- B. The Architect/Engineer shall be the sole judge of interpretations of discrepancies within the contract documents.
- C. If ambiguities should appear in the contract documents, the Contractor shall request clarification from the Architect/Engineer before proceeding with the work. If the Contractor fails to make such request, no excuse will

thereafter be entertained for failure to carry out the work in a manner satisfactory to the Architect/Engineer. Should a conflict occur within the contract documents, the Contractor is deemed to have estimated the more expensive way of doing the work unless a written clarification from the Architect/Engineer was requested and obtained before submission of proposed methods or materials.

1.6 DEFINITIONS ABBREVIATIONS

A. The following shall apply throughout the contract documents

1.	Code	All applicable national state and local codes
2.	Furnish	Supply and deliver to site ready for installation
3.	Indicated	Noted, scheduled or specified
4.	Provide	Furnish, install and connect complete and ready for final use by Owner
5.	ADA	Americans with Disabilities Act
6.	ANSI	American National Standards Institute
7.	ASTM	American Society for Testing and Materials
8.	FM	Factory Mutual System
9.	IRI	HSB Industrial Risk Insurers
10.	NEC	National Electric Code (NFPA 70)
11.	NEMA	National Electrical Manufacturers Association
12.	NFPA	National Fire Protection Association
13.	UL	Underwriters Laboratories Inc.

1.7 CODES AND STANDARDS

- A. All work shall be performed by competent craftsmen skilled in the trade involved and shall be done in a manner consistent with normal industry standards.
- B. All work shall conform to the currently adopted edition of the National Electric Code (NEC), Local Building Code, and all other applicable state and local codes or standards.
- C. Where there is a conflict between the code and the contract documents, the code shall have precedence only when it is more stringent than the contract documents. Items that are allowed by the code but are less stringent than those specified shall not be substituted.

1.8 PERMITS

- A. Contractor shall become familiar and comply with all requirements regarding permits, fees, licenses, etc. All permits, licenses, inspections and arrangements required for the work shall be obtained by Contractor's effort and expense. All utilities shall be installed in accordance with the local rules and regulations and all charges shall be paid by the Contractor. Capital facilities fees will be paid by Owner.

1.9 SUBMITTALS

- A. Division 1 section "Submittals" shall be adhered to if more stringent than this section.
- B. Shop drawings shall be submitted to Architect/Engineer for review when required by other sections of this specification and for all equipment scheduled or specified on drawings.

1. A letter of transmittal shall accompany each submittal. Submittals shall be numbered consecutively and list products covered.
2. Unless otherwise noted, submit a minimum of six (6) copies of shop drawing and product data for review.

C. Shop Drawings

1. Shop drawings include fabrication and installation drawings, diagrams, schedules of other data specifically prepared for the project. Include dimensions and notations showing compliance with specified standards.
2. Drawing sheet size shall be at least 8 ½" x 11" and no longer than 30" x 42". For sheets larger than 11" x 17", submit one sheet of reproducible media and one blue-line or photocopy print. Architect/Engineer action will be returned on reproducible media.

D. Product Data

1. Product data includes printed information, such as manufacturer's installation instructions, catalog cuts, standard color charts, rough-in diagrams, wiring diagrams and performance curves.
2. Each copy shall clearly indicate conformance with specified capacities, characteristics, dimensions and details. Mark all equipment with same item number as used on drawings. Mark each copy to clearly indicate applicable choices and options.

E. Architect/Engineer will review or take appropriate action for submittals. Review is only to determine general conformance with design shown in contract documents.

F. Architect/Engineer review of submittals shall not relieve contractor of responsibility for deviation from requirements of the contract documents or from errors or omissions within submittals.

G. No portion of the work requiring submittals shall be commenced until the Architect/Engineer has reviewed the submittal.

H. Electronic Floor Plan Drawings in AutoCAD 2002 format may be requested for use in preparation of shop drawings. Morrissey Engineering reserves the right to reject requests for electronic drawings. Electronic files shall be prepaid at \$50/sheet. Submit written request to Morrissey Engineering or email request to info@morrisseyengineering.com. Indicate the project name, and floor plan sheets requested. The use of these drawings is intended solely for preparation of drawings required by this specification. Copyright law prohibits any other use. The user of the electronic files assumes full responsibility for the accuracy and scale of the drawings.

I. See "Submittal Schedule" at the end of Section 26 01 00 – General Electrical Requirements.

1.10 OPERATION AND MAINTENANCE MANUALS

A. Assemble three (3) complete sets of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:

1. Operation Data:
 - a. Emergency instructions and procedures.
 - b. System, subsystem, and equipment descriptions, including operating standards.
 - c. Operating procedures, including startup, shutdown, seasonal, and weekend operations.
 - d. Description of controls and sequence of operations.
 - e. Piping and wiring diagrams.
2. Maintenance Data:

- a. Manufacturer's information, including list of spare parts.
 - b. Name, address, and telephone number of installer or supplier.
 - c. Maintenance procedures.
 - d. Maintenance and service schedules for preventive and routine maintenance.
 - e. Maintenance record forms.
 - f. Sources of spare parts and maintenance materials.
 - g. Copies of maintenance service agreements.
 - h. Copies of warranties and bonds.
- B. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.

1.11 PROJECT RECORD DOCUMENTS

- A. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings.
 - 1. Mark Record Prints to show the actual installation where installation varies from that shown originally.
 - 2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
 - 3. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - 4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.
 - 5. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
- B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
- C. Record Product Data: Submit one copy of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All materials and equipment used in the construction of the project shall be new unused and undamaged unless otherwise specified. Materials and equipment shall be of latest design standards of manufacturer specified.
- B. Materials and equipment are limited by the requirements of the contract documents. Material and equipment shall be provided in accordance with the following:
 - 1. Basis of Design Products: Basis of Design Products are those products around which the project was designed in terms of capacity, performance, physical size and quality. Basis of Design Products shall be provided unless substitutions are made in accordance with this specification.
 - 2. Substitutions: Substitutions are product of manufacturers other than listed as Basis of Design. Substitutions shall meet each of the following requirements and shall be subject to prior approval. Submissions requesting prior approval shall be received by the engineer no less than ten (10) days prior to project bid date.

- a. The product shall be manufactured by one of the acceptable manufacturers listed in the contract documents.
 - b. The product shall meet or exceed the requirements of the contract documents in terms of quality, performance, suitability, appearance and characteristics.
 - c. The contractor providing the substitution shall bear the total cost of all changes due to substitutions. These may include but are not limited to redesign costs and increased work by other contractors or the Owner.
 - d. The Architect/Engineer shall be the sole judge of the suitability of the substitution items.
- C. Verify installation details and requirements for materials and equipment furnished by others and installed under this contract.

PART 3 - EXECUTION

3.1 DEMONSTRATION AND TRAINING

- A. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system. Provide 4 **hours** training in up to two separate sessions.
 - 1. Provide instructors experienced in operation and maintenance procedures.
 - 2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
 - 3. Schedule training with Owner and Architect/Engineer with at least seven days' advance notice.
- B. Upon completion of the project and before final payment is made, the Contractor shall furnish the Owner with videos containing instructions for the operation and maintenance of the following equipment or systems:
- C. Videos shall meet the following criteria:
 - 1. DVD'S in .wmv, .mpeg, or other format as directed by the Owner. Each DVD shall be delivered complete with an individual storage case. Both the DVD and the storage case shall be clearly labeled with the title and date of production and the names, addresses and phone numbers of the Contractor and all people responsible for the production of the tapes.
 - 2. Videos shall be clearly titled at the beginning of the DVD and on the DVD itself. Titles shall include a list of the equipment covered within the DVD. The list shall be in order of presentation.
 - 3. The presentation shall be rehearsed.
 - 4. The video shall contain professional quality audio and video with adequate lighting of subject.
 - 5. The operation and maintenance instructions for each item of equipment shall be preceded by a title.
 - 6. The video shall contain instructions for operation and maintenance under both normal and emergency conditions.
 - 7. The video may incorporate any manufacturer video pertaining to the care, operation and/or maintenance of the item of equipment being presented.
- D. The production of videos shall not interfere with the work of other trades or with the work of the Owner's personnel. Coordination with other trades and with the Owner shall be the responsibility of the Contractor.
- E. Instructional videos may be produced in conjunction with the operation instructions required above.

3.2 STARTING AND ADJUSTING

- A. Start and test all equipment and operating components to confirm proper operation. Test and adjust all systems to achieve designed capacity and performance.

- B. Provide three (3) copies of all test report to the Architect/Engineer for review prior to date of substantial completion.
- C. All equipment and systems discrepancies shall be corrected prior to final acceptance.

3.3 TEMPORARY POWER AND LIGHTING

- A. Electric Power Service: Provide temporary electric power from local utility with metering and with payment of use charges.
- B. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and construction equipment.
- C. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations and traffic conditions.

ELECTRICAL SUBMITTAL SCHEDULE

Refer to individual specification sections for additional requirements and detail on each submittal.

Section	Section Name	Product Data	Shop Dwg	Test Reports / Quality Control	Warranty	Extra Materials	O&M Data	Record Docs	Demonstration / Training
260100	General Electrical Requirements	√	√						
260500	Basic Electrical Materials and Methods	√	√						
260600	Grounding and Bonding	√							
262200	Dry Type Transformers	√			√		√		
262416	Panelboards	√	√		√		√		
262726	Wiring Devices	√	√				√		
262816	Disconnect Switches and Circuit Breakers	√			√		√		
264313	Surge Protective Devices (SPD's)	√			√		√		
265100	Lighting	√	√		√		√		

END OF SECTION 26 01 00

SECTION 26 05 00 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. The Owner has contracted directly with the Commissioning Authority (CxA) for this project. All Contractors shall co-operate with the CxA to complete all required commissioning. Specification Section 01 91 13 defines the Contractor's responsibilities with respect to the process. The Contractor shall review this section and shall include in their bids the work associated with the commissioning effort described.

1.2 SUMMARY

- A. This Section includes the following basic electrical materials and methods and shall apply to all phases of the work specified, indicated on the drawings or required to provide for complete installation of electrical systems.
 - 1. Conduits.
 - 2. Building wire and connectors.
 - 3. Supporting devices for electrical components.
 - 4. Outlet boxes.
 - 5. Electrical identification.
 - 6. Cutting and patching for electrical construction.
 - 7. Fire Stopping.
 - 8. Touchup painting.

1.3 MATERIAL QUALITY ASSURANCE

- A. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.4 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
 - 1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- B. Sequence, coordinate, and integrate installing of electrical materials and equipment with other trades.
- C. Coordinate installing large equipment requiring positioning before closing in the building.
- D. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.

- E. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
- F. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.
- G. Motors, equipment, controls, etc. shall be furnished, mounted and connected according to the following schedule unless otherwise noted (E =Electrical Contractor, M =Mechanical Contractor):

H. Item		Furnished By	Set in place or mounted by	Power wiring and connection by	Control Wiring and connection by
1)	Equipment Motors	M	M	E	M
2)	Magnetic Motor Starters:				
a)	Automatically controlled, with or without HOA switches.	E	E	E	M
b)	Automatically controlled, with or without HOA switches and furnished as part of factory-wired mechanical equipment	M	M	E	M
c)	Manually controlled	E	E	E	---
d)	Manually controlled and furnished as part of factory-wired mechanical equipment	M	M	E	---
3)	Disconnect switches, thermal overload switches, manual operating switches				
a)	Furnished as part of factory wired mechanical equipment	M	M	E	--
b)	Loose mounted	E	E	E	--
4)	Transformers				
a)	Serving 120 Volt and higher loads	E	E	E	--
b)	Serving 24 Volt control power	M(1)	M	E	M
5)	Contactors	E	E	E	E
6)	Push-button stations, pilot lights	E	E	E	E
7)	Line voltage thermostats and time clocks.	M	E	E	E
8)	Low voltage controls and thermostats	M	M	M	M(2)
9)	Motorized valves, and float controls for tanks and sumps	M	M	E	M
10)	Motorized control valves, damper motors, solenoid valves, etc.				
a)	Line Voltage	M	M	E	M
b)	Low Voltage	M	M	M	M
11)	Factory pre-wired control/power panels including remote sensing devices	M	M	E	M(3)

I. Notes:

1. When control power is not available, mechanical contractor shall provide control transformers as required to power all valves, dampers, etc.
2. Conduit rough-in for thermostats by electrical contractor.
3. Remote condensing units and heat pumps control wiring including wiring of remote sensors by mechanical. Control circuit feeders by mechanical unless shown otherwise.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Each contractor shall make provisions for delivery and safe storage of materials. Materials shall be delivered in a timely manner to expedite the work.
- B. Protect stored piping, supplies and equipment from cold, moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

PART 2 - PRODUCTS

2.1 CONDUITS

- A. Electrical metallic tubing (EMT): ANSI C80.3 and UL 797, zinc-coated steel with steel or die cast, set-screw or compression type fittings.
 1. Color coded exterior for system identification:
 - a. Fire Alarm – Red.
 - b. Power – Silver.
 - c. Security – Orange.
 - d. Communications – Blue.
- B. Flexible metal conduit (FMC): UL 1, Zinc-coated steel.
- C. Intermediate metal conduit (IMC): ANSI C80.6 and UL 1242, zinc-coated steel, with threaded fittings.
- D. Liquidtight flexible metal conduit (LFMC): Flexible steel conduit with PVC jacket and complying with UL 360.
- E. Rigid nonmetallic conduit (RNC): NEMA TC 2 and UL 651, EPC-40 (schedule 40) PVC, with NEMA TC3 fittings.
- F. Installation location shall determine conduit type permitted.
 1. For indoor installations:
 - a. Exposed: EMT.
 - b. Concealed: EMT.
 - c. Connection to vibrating equipment: FMC; except in wet or damp locations, use LFMC.
 - d. Boxes and enclosures: NEMA 250, Type 1, unless otherwise indicated.
 2. Use the following conduits for outdoor installations:
 - a. Exposed: IMC.
 - b. Underground: RNC.

- c. Boxes and enclosures: NEMA 250, Type 3R or Type 4.
- 3. At motors:
 - a. Connect motors and equipment subject to vibration, noise transmission, or movement with FMC of 72-inch maximum length.
 - b. Damp locations: LFMC.
- G. Conduit fittings: Specifically designed for the conduit type with which used. Comply with NEMA FB 1 and UL 514B.

2.2 CONDUCTORS

- A. Conductors and conductor insulation: Comply with NEMA WC 70.
- B. Conductors, No. 10 AWG and Smaller: Solid or stranded copper.
- C. Conductors, larger than No. 10 AWG: Stranded copper.
- D. Insulation: thermoplastic, rated at 75 deg C minimum.
 - 1. Feeders: Type THHN/THWN insulated conductors in conduit.
 - 2. Underground Feeders and Branch Circuits: Type THWN in conduit.
 - 3. Branch Circuits: Type THHN/THWN insulated conductors in conduit.
 - 4. Circuits over 100 feet from GFCI devices and all circuits from line isolation panels: Low-leakage XHHW in conduit.
- E. Wire connectors and splices: Units of size, ampacity rating, material, type, and class suitable for service indicated.
- F. Unless otherwise indicated on the drawings, circuits are to be 20 amps with #12 AWG wire.
- G. A green ground shall be installed with all branch and feeder circuits. Unless otherwise indicated on the drawings, ground wires are to be #12 AWG.
- H. Provide a dedicated neutral conductor for each 120V and 277V branch circuit unless otherwise indicated on drawings.

2.3 SUPPORTING DEVICES

- A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
- B. Metal items for use outdoors or in damp locations: Hot-dip galvanized steel.
- C. Slotted-steel channel supports: Flange edges turned toward web, and 9/16-inch- diameter slotted holes at a maximum of 2 inches o.c., in webs.
- D. Conduit and cable supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
 - 1. In general, use the following support methods for outdoor conduit installations:
 - a. Individual exposed conduit: 1" and smaller; 2 hole straps.
 - b. Individual exposed conduit: 1-1/4" and larger; Minerallac.
 - c. Paired individual exposed conduit: Minerallac.

- d. Rack exposed conduit: Unistrut with strut straps.
- e. Concealed in concrete pour: Approved iron tie wire.

2. In general, use the following support methods for indoor conduit installations:

- a. Individual exposed conduit: 1" and smaller; 2 hole straps.
- b. Individual exposed conduit: 1-1/4" and larger; Minerallac.
- c. Individual lighting and power above lay-in ceilings: Dedicated ceiling wire with Caddy clips.
- d. Racked exposed or concealed conduit: Unistrut with strut straps.

- E. Pipe sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- F. Expansion anchors: Carbon-steel wedge or sleeve type.
- G. Toggle bolts: All-steel springhead type.
- H. Powder-driven threaded studs: Heat-treated steel.

2.4 BOXES

- A. Hollow wall and ceiling spaces: Outlet boxes for concealed applications shall be 4" square with single or multiple gang plaster ring in round or square configuration to match the device or fixture being installed. Depth of ring shall be selected so that face of ring is recessed back from face of finished surface by approximately 1/8".
- B. Masonry walls: Outlet boxes in masonry walls shall be 4" square with single or multiple gang masonry rings with square edges. Masonry boxes may also be used where 4" square boxes are impractical. Slush boxes in place to prevent movement within walls. **Flush mounted boxes and conduit are to be used unless otherwise indicated.**
- C. Exposed exterior boxes: Where exposed boxes are required, they shall be the cast type with threaded hubs and gasketed covers. Use of these boxes is by approval only. Flush mounted boxes and conduit are to be used unless otherwise indicated.
- D. Interior junction boxes: Interior junction boxes shall be 4" square minimum with knock outs as required. Larger boxes may be required and shall be sized per NEC. Provide a flat steel coverplate.
- E. Specialty junction boxes larger than 4 11/16": Junction and pull boxes shall be sized per NEC and arranged to facilitate pulling or splicing. Boxes shall be steel without knock outs, with hinged or screw on cover plates.
- F. Floor boxes: See "Wiring Devices" Specification or the drawings.

2.5 ELECTRICAL IDENTIFICATION

- A. Underground warning tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:
 - 1. Not less than 6 inches wide by 4 mils thick.
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed legend that indicates type of underground line.
- B. Tape markers for wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

- C. Engraved-plastic labels, signs, and instruction plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch minimum thickness for signs up to 20 sq. in. and 1/8-inch minimum thickness for larger sizes. Engraved legend in black letters on white background.

2.6 ACCESS DOORS

- A. Prime coated 14 gauge steel, flush, with screw driver operated cam lock. Frame to accommodate construction type; size as indicated.

PART 3 - EXECUTION

3.1 UTILITY COORDINATION

- A. Utility locations indicated on drawings are approximate and the most accurate information available at the time of design. Prior to equipment and conduit installation, the contractor shall coordinate exact installation details and modify work plan accordingly to meet utility requirements. Correspond with utility company prior to any site development that may impact the installation such as irrigation installation, concrete or asphalt installation, landscaping, etc.
- B. Contact utility locating services prior to digging.

3.2 ELECTRICAL EQUIPMENT INSTALLATION

- A. Quality of workmanship: A neat and workmanlike installation shall be provided as defined in the National Electrical Installation Standards (NEIS) established by the National Electrical Contractors Association (NECA). NEIS standards shall be followed for all work including that which is concealed by construction.
- B. Neatness and craftsmanship shall be a priority. Installations shall be subject to regular observations performed by the Engineer or the Engineer's Representative. If an installation is deemed unsatisfactory by the Engineer or the Engineer's Representative due to quality of workmanship, code conflicts or deviations from the Construction Drawings or Specifications, the Contractor shall remedy the installation to the satisfaction of the Engineer.
- C. Inspect installed components for damage and faulty work, including the following:
 - 1. Conduits.
 - 2. Building wire and connectors.
 - 3. Supporting devices for electrical components.
 - 4. Electrical identification.
 - 5. Concrete bases.
 - 6. Cutting and patching for electrical construction.
 - 7. Touchup painting.
- D. Headroom maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- E. Materials and components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- F. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

- G. Right of way: Give to conduits and piping systems installed at a required slope.

3.3 CONDUIT AND CABLE INSTALLATION

- A. Conceal conduit and cables, unless otherwise indicated, within finished walls, ceilings, and floors.
- B. Install conduit and cables at least 6 inches away from parallel runs of flues or hot-water pipes. Locate horizontal conduit runs above water piping.
- C. Use temporary conduit caps to prevent foreign matter from entering.
- D. Make conduit bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
- E. Use conduit and cable fittings compatible with conduit and cables and suitable for use and location.
- F. Conduits may be installed embedded in concrete under the following conditions:
 - 1. Contractor shall receive approval from a structural engineer if conduit is to be located in structural concrete.
 - 2. Leave at least 2-inch concrete cover.
 - 3. Do not displace more than 1/3 of the concrete thickness of the slab. For example, if the slab thickness is 3", maximum conduit size is to be 1" OD.
 - 4. Secure conduit to reinforcing rods to prevent sagging or shifting during concrete placement.
 - 5. Where multiple conduits are run in an area, space conduit laterally to prevent voids in concrete. Fan out conduit runs for a minimum spacing of no less than 3 times the diameter of the larger conduit in a group. Do not place conduits within 12" of supporting beams, walls and columns.
 - 6. Install conduit larger than 1-inch trade size parallel to or at right angles to main reinforcement. Where conduit is at right angles to reinforcement, place conduit close to slab support.
 - 7. Where floor finish is to be exposed concrete, avoid excessive underfloor conduits and maximize cover over conduits to avoid floor cracking.
 - 8. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.
- G. Make bends in exposed parallel or banked runs from same centerline to make bends parallel. Use factory elbows where elbows can be installed parallel; otherwise, provide field bends for exposed parallel conduits.
- H. Install pull wires in empty conduits. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of the pull wire.
- I. Install interior telephone and signal system conduits in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements, in addition to requirements above.
- J. Install exterior telephone and signal system conduits in maximum lengths of 500 feet and with a minimal number of 90-degree bends.
- K. Utilize sweep elbows for all telephone and signal system conduits 2" and larger.
- L. All **conduits routed through unfinished spaces** shall be routed as high as allowable to avoid future conflicts with build out.

- M. Avoid routing conduits through front-of-house areas with exposed ceilings as much as possible. All conduits routed exposed in finished spaces shall be painted to match the surroundings. Unless otherwise required by Code, this shall include fire alarm, communication, or other color-specific conduits.
- N. Route conduits parallel to building structural members in a neat and orderly manner.
- O. Set floor boxes level and trim after installation to fit flush to finished floor surface.

3.4 CONDUIT SUPPORT INSTALLATION

- A. Install support devices to securely and permanently fasten and support electrical components.
- B. Install individual and multiple conduit hangers and riser clamps to support conduits. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Size supports for multiple conduits so capacity can be increased by a 25 percent minimum in the future.
- D. Install 1/4-inch diameter or larger threaded steel hanger rods, unless otherwise indicated.
- E. Simultaneously install vertical conductor supports with conductors.
- F. Separately support cast boxes that are threaded to conduits and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to conduits on opposite sides of the box and support the conduit with an approved fastener not more than 24 inches from the box.
- G. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength. Use factory hardware for all connections and assemblies including 45 and 90 degree attachment hardware.
- H. Install sleeves for cable and conduit penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and conduit penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- I. Install PVC sleeves for grounding cable riser penetrations of concrete slabs. Where ground wires are run through metal sleeves use grounding bushings on both ends of the conduit or sleeve.
- J. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
 - 1. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
 - 2. New concrete: Concrete inserts with machine screws and bolts.
 - 3. Light steel: Sheet-metal screws.
 - 4. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.5 WIRING INSTALLATION

- A. Install splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- B. Install wiring at outlets with at least 12 inches of slack conductor at each outlet.

- C. Connect outlet and component connections to wiring systems and to ground. Tighten electrical connectors and terminals, according to manufacturer's published torque-tightening values.

3.6 POSITION OF DEVICE OUTLETS

- A. Outlets shall be installed at the height indicated below unless otherwise noted. All heights of outlets are measured from finished floor to centerline of device. Heights may be adjusted as necessary to clear wall mounted cabinets, fin tube convectors, unit heaters, etc. Where installed in masonry walls, mounting heights may be adjusted to correspond to block coursing. In no case shall outlets be mounted below 15" or switches above 48":
 - 1. Wall switches 44".
 - 2. Receptacle outlet (general) 16".
 - 3. Receptacle outlet serving countertops 4" above counter or top of backsplash unless otherwise noted.
 - 4. Exterior receptacles 24"
 - 5. Communications outlet Match adjacent outlets.
 - 6. Communication system call station 44".

3.7 ELECTRICAL IDENTIFICATION

- A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.
- C. Self-Adhesive Identification Products: Clean surfaces before applying.
- D. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.
- E. Install warning markers directly above power and communication lines during trench backfilling for underground power, control, signal, and communication lines. Locate marker 6 to 8 inches below finished grade unless required otherwise by NEC. Markers shall be continuous and detectable with a metal detector from above ground after backfilling. Provide one strip of marker for each 16 inches of width if multiple lines are installed in a common trench or concrete envelope.
- F. Color-code 208/120-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:
 - 1. Phase A: Black.
 - 2. Phase B: Red.
 - 3. Phase C: Blue.
 - 4. Neutral: White.
 - 5. Ground: Green.
- G. Color-code 480/277-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:
 - 1. Phase A: Brown
 - 2. Phase B: Orange
 - 3. Phase C: Yellow
 - 4. Neutral: White with a colored stripe or gray

5. Ground: Green.

3.8 FIRESTOPPING

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly and to resist passage of smoke and other gases. Products designed to achieve a fire or smoke resistance rating shall not be used in locations where such ratings are not required by AHJ. Coordinate location requirements with other disciplines and AHJ prior to installation.
1. Limit air leakage to 5.0cfm per square foot tested in accordance with UL 1479.
 2. Materials labeled by a qualified testing agency acceptable to AHJ.
 3. Comply with manufacturer's written installation instructions and published drawings
 4. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - a. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - b. Contractor's name, address, and phone number.
 - c. Designation of applicable testing and inspecting agency.
 - d. Date of installation.
 - e. Manufacturer's name.
 - f. Installer's name.
- B. All firestopping assemblies shall be from one manufacturer. Match manufacturer used by other trades or as directed by general contractor.
- C. Where electrical outlets are to be installed in fire rated walls, provide FlameSafe FSP1077 putty pads or equal to maintain adequate fire rating.
- D. Where lighting fixtures or other electrical devices are to be installed in fire rated ceilings, provide Tenmat Fire Rated Light Covers or equal to maintain adequate fire rating.

3.9 HOUSEKEEPING PADS

- A. Provide a 3-1/2 inch tall concrete housekeeping pad for all floor mounted interior electrical equipment as follows:
1. Pad shall extend 4-6" beyond all sides of equipment, except in the back for switchboards mounted tight against the wall.
 2. Constructed of 3000 psi concrete.
 3. Provide 6" x 6" #4 welded wire mesh.
 4. Securely bond pad to floor by roughing the floor and coating with cement grout.

3.10 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair cut surfaces to match adjacent surfaces.

3.11 CONSTRUCTION LAYOUT

- A. Layout work in advance of installation using data and measurements from the site, the appropriate architectural and structural drawings and shop drawings.
- B. Confirm adequate clearance for installation, operation, maintenance and code required clearance including items installed by other contractors.
- C. If layout to provide clearance is not possible, promptly notify Architect/Engineer for clarification.

3.12 DATA AND MEASUREMENTS

- A. The data given herein and on the drawings is as accurate as could be secured. The existence and location of construction as indicated is not guaranteed. Before beginning work investigate and verify the existence and location of items affecting work. Obtain exact locations, measurements, levels, etc., at the site and adapt work to actual conditions.
- B. Only Architectural drawings, Structural drawings, and site measurements may be utilized in calculations. Mechanical and electrical drawings are diagrammatic or schematic.

3.13 COMMISSIONING

- A. Participate in the commissioning process under the direction of the commissioning authority. Representative with expertise and authority to act on contractor's behalf shall perform commissioning activities including, but not limited to, the following:
 - 1. Coordinate and integrate commissioning process activities with construction schedule.
 - 2. Attend meetings held on a regular basis at intervals determined by commissioning authority.
 - 3. Supply product documentation.
 - 4. Complete construction checklists provided by commissioning authority.
 - 5. Review and accept commissioning process test procedures provided by the Commissioning Authority.
 - 6. Complete commissioning process test procedures and functional testing.
 - 7. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
 - 8. Cooperate with the commissioning authority for resolution of logged issues.

3.14 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint.
 - 1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
 - 2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
 - 3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.15 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 26 05 00

SECTION 26 06 00 - GROUNDING AND BONDING

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 methods and materials for grounding systems and equipment. plus the following special applications:
 - 1. Bond rebar and other metal accessories at pool per NEC 680

1.3 SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For grounding, include the following in emergency, operation, and maintenance manuals:
 - 1. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NFPA 70B.
 - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.

3. Tinned Conductors: ASTM B 33.
4. Bonding Conductor: See riser diagram.

C. Grounding Bus Bars:

1. Rectangular annealed copper bar
2. .25" nominal thickness
3. Dimensions: See drawings
4. Stainless steel wall brackets with insulators, 5/8" diameter mounting bolts with lock washers

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 1. Pipe Connectors: Clamp type, sized for pipe.
 2. Bus Bars: Compression type, two hole.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, 5/8" diameter by 120 inches.
- B. Ufer Ground (Concrete-Encased Grounding Electrode): #3/0 bare copper in 25' of concrete footing.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 3/0 **[insert size]** AWG minimum.
 1. Bury at least 24 inches (600 mm) below grade.
- C. Conductor Terminations and Connections:
 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 2. Underground Connections: Welded connectors
 3. Connections to Ground Rods: Bolted connectors.
 4. Connections to Conduits: Insulated grounding bushings
 5. Connections to Busbars: Bolted connections.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Install two parallel ground rods if resistance to ground by a single, ground-rod electrode exceeds 25 ohms.
- C. Drive ground rods until tops are 12 inches (300 mm) below finished grade in undisturbed earth.
- D. Ground-Rod Connections: Install bolted connectors for underground connections and connections to rods.
- E. Lightning Arrester Grounding Conductors: Separate from other grounding conductors.
- F. Secondary Neutral and Transformer Enclosure: Interconnect and connect to grounding conductor.
- G. Protect grounding conductors running on surface of wood poles with molding extended from grade level up to and through communication service and transformer spaces.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. All feeders and branch circuits, including:
 - a. Feeders and branch circuits.
 - b. Lighting circuits.
 - c. Receptacle circuits.
 - d. Single-phase motor and appliance branch circuits.
 - e. Three-phase motor and appliance branch circuits.
 - f. Flexible raceway runs.
- C. Pool: Bond steel reinforcing around pool and metallic parts within pool area not tied to reinforcing steel with #8 bare copper conductor per NEC 680-22.
- D. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- D. Bonding for Metal Enclosed Panelboards: Provide insulated grounding bushings and #4 AWG jumper on conduit that does not terminate in panelboard enclosure bottom plate.
- E. Grounding and Bonding for Piping:
1. Metal Water Service Pipe, Including Fire Service: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Ufer Ground (Concrete-Encased Grounding Electrode): Install according to NFPA 70, using a minimum of 25' of bare copper conductor not smaller than No. 3/0 in concrete footing.
1. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and

observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 - 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 - 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
- H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect/Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 06 00

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes load centers and panelboards, overcurrent protective devices and associated auxiliary equipment rated 600V and less for the following types:
 - 1. Lighting and appliance branch-circuit panelboards.
 - 2. Distribution panelboards.
- B. Related Sections include the following:
 - 1. Division 26 Section "General Electrical Requirements."
 - 2. Division 26 Section "Basic Electrical Materials and Methods."
 - 3. Division 26 Section "Grounding and Bonding."
 - 4. Division 26 Section "Network Energy Monitoring."
 - 5. Division 26 Section "Surge Protective Devices (SPDs)."

1.3 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Panel designation (same as on drawings).
 - c. Bus configuration, current, and voltage ratings.
 - d. Short-circuit current rating of panelboards and overcurrent protective devices.
 - e. UL listing for series rating of installed devices.
 - f. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices, and auxiliary components.
 - g. SPD devices when integrated into equipment.
 - h. Accessories (ground bar, contactor, door lock, etc.)
 - i. Mounting (flush or surface).
 - 2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.

- C. Maintenance Data: For panelboards and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Contract Closeout," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.4 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to work-space clearance requirements.

1.5 EXTRA MATERIALS

- A. Keys: Four spares of each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. Eaton Corp.; Cutler-Hammer Products.
 - b. GE/ABB.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D Co.
 - 2. Fused Coordination Panelboards, Overcurrent Protective Devices, and Accessories:
 - a. Cooper-Bussman – Quick Spec Coordination Panelboard.
 - b. Mersen Fused Coordination Panelboard

2.2 FABRICATION AND FEATURES

- A. Enclosures: Flush- and surface-mounted cabinets. NEMA PB 1, Type 1, to meet environmental conditions at installed location.
 - 1. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
- B. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
- C. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
- D. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.
- E. Bus: Hard-drawn copper, 98 percent conductivity or Tin-plated aluminum.

- F. Main and Neutral Lugs: Mechanical type suitable for use with conductor material.
- G. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
- H. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.
- I. Select lug option, maintain similar lug style accepted above.
- J. Feed-through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

2.3 PANELBOARD SHORT-CIRCUIT RATING

- A. UL label indicating series-connected rating with integral or remote upstream devices. Include size and type of upstream device allowable, branch devices allowable, and UL series-connected short-circuit rating.

2.4 Delete paragraph and subparagraphs below if load centers are not utilized on project. Load centers are common for residential applications.

2.5 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Select one of the options in the paragraph below. Bolt-on breakers are most common. Plug-in breakers are more common in residential load centers.
- B. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- C. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- D. Load center construction shall not be acceptable.

2.6 SURGE PROTECTIVE DEVICE (SPD)

- A. Panelboard configured to physically accommodate integration of a SPD.
- B. Panelboard phase, neutral, and ground busses configured to accommodate an integral SPD with leads for each mode no longer than 12.

2.7 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Electronic Trip Unit Circuit Breakers for breaker frame sizes 800 A and larger: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - a. Instantaneous trip.

- b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
- 3. GFCI Circuit Breakers: Single- and two-pole configurations with 5mA trip sensitivity.
- B. Molded-Case Circuit-Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.
 - 1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
 - 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 - 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
- C. Retain paragraph below for fusible distribution panelboards.

2.8 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Mounting Heights:
 - 1. General: Top of trim 74 inches above finished floor, unless otherwise indicated.
- C. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- D. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- E. Install filler plates in unused spaces.
- F. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.
- G. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Basic Electrical Materials and Methods"
- B. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

- A. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.
- B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:
 - 1. Measure as directed during period of normal system loading.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data-processing, computing, transmitting, and receiving equipment.
 - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.5 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.6 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes receptacles, connectors, switches, and finish plates.
- B. This Section includes floor boxes and poke-thru floor fittings.

1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. DL: Damp location as defined in NFPA 70, Article 100.
- C. WP: Weatherproof for wet locations as defined in NFPA 70, Article 100.

1.4 SUBMITTALS

- A. Product Data: For each product specified.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- B. Comply with NEMA WD 1.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Other Wiring Devices
 - a. Bryant Electric, Inc.
 - b. Cooper Wiring Devices.
 - c. Hubbell, Inc.; Wiring Devices Div.
 - d. Leviton Manufacturing Co., Inc.
 - e. Pass & Seymour/Legrand; Wiring Devices Div.

2.2 RECEPTACLES

- A. Description: Impact-resistant nylon face with finger groove, thermoplastic back body, and one-piece triple-wipe power contacts. Side and back wired, back wire terminals use screw pressure plates.
- B. Duplex Straight-Blade Receptacles: Specification grade; 20 ampere, 125 volt rated.
1. Equal to: Pass & Seymour #5362
- C. GFCI Receptacles: Design units for installation in a 2-3/4-inch deep outlet box without an adapter.
1. Equal to: Pass & Seymour #2097.
- D. Weather-Resistant Duplex Receptacle: Specification grade, 20 ampere, 125 volt rated.
1. Equal to: Pass & Seymour #WR5362

2.3 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
1. Cord: Rubber-insulated, stranded-copper conductors, with type SOW-A jacket. Green-insulated grounding conductor, and equipment-rating ampacity plus a minimum of 30 percent.
 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.4 SWITCHES

- A. Snap Switches: Specification grade; 20 ampere, 120/277 volt rated; side and back wired; quiet type.
1. Poles: Provide switches in single-pole, double-pole, three-way, and four-way configurations as indicated on the drawings.
 2. Equal to: Pass & Seymour #20AC

2.5 WALL PLATES

- A. Single and combination types match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Select one of five subparagraphs below. Coordinate with Division 9 Section "Painting."
 - 3. Material for Finished Spaces: 0.04-inch thick, Type 302, satin-finished stainless steel.
 - a. Ceiling mounted wall plates to match ceiling color.
 - 4. Material for Unfinished Spaces: Galvanized steel.
 - 5. Weatherproof plates in damp locations (DL): Heavy cast aluminum; hinged, gasketed, equal to Pass & Seymour #4511 for horizontal mount or #4512 for vertical mount. These covers shall be installed outdoors in a location protected from the weather such as roofed open porches, canopies, eaves, and the like or in other damp locations where the receptacle will not be subject to beating rain or water run-off.
 - 6. Weatherproof while-in-use plates in wet locations (WP): Expanding polycarbonate cover and the integrity of the assembly is not affected when the attachment plug cap is inserted. Equal to Taymac Extra Duty ML500 or ML2500. Select model coordinated with number of gangs and device orientation of indicated location.

2.6 FINISHES

- A. Color:
 - 1. Gray, unless otherwise indicated for normal circuits.
 - a. Ceiling mounted devices to match ceiling color.
 - 2. Red, unless otherwise indicated for generator power circuits.

2.7 CIRCUIT LABELS FOR RECEPTACLES

- A. Brother PC clear adhesive with Arial #14 black lettering for normal circuits.
- B. Brother PC clear adhesive with Arial #14 red lettering for emergency circuits.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install devices and assemblies plumb and secure.
- B. Install wall plates when painting is complete.
- C. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on bottom. Group adjacent switches under single, multigang wall plates.
- D. Do not share neutral conductor on load side of dimmers.
- E. Protect devices and assemblies during painting.

- F. Provide a GFCI receptacle for each device indicated on the drawings. Do not connect GFCI receptacles to protect downstream devices.
- G. Set floor boxes level and trim after installation to fit flush to finished floor surface.

3.2 IDENTIFICATION

- A. Comply with Division 26 Section "Basic Electrical Materials and Methods."
 - 1. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.
 - 2. Receptacles: Identify serving panelboard and circuit number on faceplate of all receptacles.
 - 3. Conductors Serving Receptacles: Identify serving panelboard and circuit number. Use durable wire markers or tags within outlet boxes.

3.3 CONNECTIONS

- A. Connect wiring device grounding terminal to outlet box with bonding jumper.
- B. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.
- C. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values.

3.4 FIELD QUALITY CONTROL

- A. Test wiring devices for proper polarity and ground continuity.
- B. Test GFCI operation with fault simulations according to manufacturer's written instructions.
- C. Replace damaged or defective components.

3.5 CLEANING

- A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION 26 27 26

SECTION 26 43 13 – SURGE PROTECTIVE DEVICES (SPD'S)

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 permanently installed, factory or field mounted, 1kV or less surge protective device (SPD) equipment.

1.3 DEFINITIONS

- A. Type 1 SPD: Referred to as secondary surge arrestors prior to the 2008 NEC. These devices are designed for installation on the line side of the service entrance disconnect and must have integrated overcurrent protection.
- B. Type 2 SPD: Referred to as hardwired transient voltage surge suppressors (TVSS) prior to the 2008 NEC. These devices are designed for installation at any location on the load side of the service disconnect. External overcurrent protection is allowed.
- C. Type 4 SPD: SPD components intended to be part of a complete SPD.
- D. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For SPD devices to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.
- B. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.
- C. Comply with UL 1283 2nd Edition.
- D. Comply with UL 1449 3rd Edition.
- E. Comply with NFPA 70, 2008 Edition.

- F. [Comply with NFPA 780.]

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
1. Notify Construction Manager no fewer than 14 days in advance of proposed electrical service interruptions.
 2. Do not proceed with interruption of electrical service without Owner's written permission.
- B. Service Conditions: Rate SPDs for continuous operation under the following conditions unless otherwise indicated:
1. Maximum Continuous Operating Voltage: Not less than 125 percent of nominal system operating voltage.
 2. Operating Temperature: 30 to 120 deg F.
 3. Humidity: 0 to 85 percent, noncondensing.
 4. Altitude: Less than 20,000 feet above sea level.

1.8 COORDINATION

- A. Coordinate location of field-mounted SPDs to allow adequate clearances for maintenance.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Designed for integration into selected switchgear/switchboard/panelboard manufacturer's equipment.
1. Panel arrangement allowing maximum lead length to phase, neutral, and ground bus connection points of 8".
- B. Subject to compliance with requirements, provide product by one of the following:
1. Advanced Protection Technologies, Inc. (APT).
 2. Cutler-Hammer; Eaton Business Unit.
 3. GE/ABB Zenith.
 4. Innovative Technology; Eaton Business Unit.
 5. LEA International.
 6. Liebert; Emerson Network Power Business Unit.
 7. Siemens.
 8. SurgeLogic/Square D; Schneider Electric Business Unit.
- C. SPD for Service Entrance Equipment Location (Primary Protection)

1. UL listed to UL 1449 3rd Edition
2. Type 1 (installed downstream of main breaker) or Type 2.
3. 20kA nominal discharge (In).
4. Short-circuit current rating (SCCR) complying with UL 1449, and matching or exceeding the connected equipment short-circuit rating.
5. 7 modes of protection (L-N, L-G, N-G).
6. Peak surge current rating: 200kA per phase.
7. VPR: Not to exceed 700V for 208Y/120V systems, 1200V for 480Y/277V systems.
8. System voltage: match service entrance equipment.
9. EMI/RFI noise rejection filter: Noise attenuation of 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method.
10. LED indicator lights for power and protection status.
11. Audible alarm, with silencing switch, to indicate when protection has failed.
12. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
13. Six-digit transient-event counter set to totalize transient surges.

D. SPDs for Non-Service Entrance Equipment Locations (Secondary Protection)

1. UL listed to UL 1449 3rd Edition
2. Type 1 (installed downstream of main breaker) or Type 2.
3. 20kA nominal discharge (In).
4. Short-circuit current rating (SCCR) complying with UL 1449, and matching or exceeding the connected equipment short-circuit rating and.
5. 7 modes of protection (L-N, L-G, N-G).
6. Peak surge current rating: 100kA per phase.
7. VPR: Not to exceed 700V for 208Y/120V systems, 1200V for 480Y/277V systems.
8. System voltage: match connected equipment.
9. EMI/RFI noise rejection filter: Noise attenuation of 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method.
10. LED indicator lights for power and protection status.
11. Audible alarm, with silencing switch, to indicate when protection has failed.
12. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
13. [Six-digit transient-event counter set to totalize transient surges.]

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install SPD devices at service entrance on load side of main disconnect, with ground lead bonded to service entrance ground.
- B. Install SPD devices for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
 1. Comply with manufacturer's written recommendation for conductor and circuit-breaker size for connecting SPD devices to distribution system.
- C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.
2. After installing SPD devices but before electrical circuitry has been energized, test for compliance with requirements.
3. Complete startup checks according to manufacturer's written instructions.
4. Coordinate with commissioning agent. Supply requested product documentation.

D. SPD device will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.2 STARTUP SERVICE

A. Do not energize or connect panelboards to their sources until SPDs are installed and connected.

B. Do not perform insulation resistance tests of the distribution wiring equipment with the SPD installed. Disconnect before conducting insulation resistance tests, and reconnect immediately after the testing is over.

3.3 DEMONSTRATION

A. Train Owner's maintenance personnel to maintain SPD devices.

END OF SECTION 26 43 13

SECTION 26 51 00 - LIGHTING

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. See 26 05 00 "Basic Electrical Materials and Methods" for electrical materials and methods.
- C. See 26 27 26 "Wiring Devices" for manual light switches and device finishes.
- D. See 26 52 00 "Lighting Control" for lighting control devices.
- E. The Owner has contracted directly with the Commissioning Authority (CxA) for this project. All Contractors shall cooperate with the CxA to complete all required commissioning. Specification Section 01 91 13 defines the Contractor's responsibilities with respect to the process. The Contractor shall review this section and shall include in their bids the work associated with the commissioning effort described.

1.2 SUMMARY

- A. This Section includes luminaires, lamps, ballasts, drivers, emergency lighting units, emergency battery packs, emergency lighting inverters, exit signs, luminaire supports, poles, and accessories.

1.3 SUBMITTALS

- A. Product Data: For each luminaire type arranged in order of type designation. Include data on features, accessories, and the following:
 - 1. Physical description including dimensions, construction, and finish.
 - 2. Lamp and ballast data indicating rated life, output, CCT, CRI, and energy use.
 - 3. LED and driver data indicating rated life, output (delivered), CCT, CRI, and energy use.
 - 4. Photometric report including IES files.
 - 5. Emergency lighting units, including batteries and chargers.
- B. Product Data: For each pole type arranged in order of type designation. Include data on features, accessories, and the following:
 - 1. Include data on construction details, profiles, EPA, cable entrances, materials, finishes, dimensions, weight, rated design load, and ultimate strength of individual components.
 - 2. Anchor bolts.
- C. Product Data: For each type and rating of emergency lighting inverter.
 - 1. Include features, performance, electrical ratings, operating characteristics, furnished options, and accessories.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, ventilation requirements, method of field assembly, and components.
 - 3. Include system one-line diagram, internal and interconnecting wiring; and diagrams for power, signal, and control wiring.

- D. Shop Drawings: For non-standard or custom luminaires. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- E. Maintenance Data: For luminaires to include in maintenance manuals specified in Division 1.
- F. Samples for Initial Selection: For each luminaire requested by architect or engineer.
 - 1. Include Samples of luminaires and accessories involving color and finish selection.

1.4 QUALITY ASSURANCE

- A. Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- B. Comply with NFPA 70 and 101.
- C. Emergency lighting units, inverters, exit signs, and batteries: Comply with UL 924.
- D. Exterior Lighting: Comply with UL 1598 and listed for wet location.
- E. Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

1.5 COORDINATION

- A. Luminaires, Mounting Hardware, and Trim: Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Coordinate layout and installation of devices with other construction including structural members, underground utilities, above-grade utilities, site design, and building elements.
- C. Coordinate layout and installation of emergency lighting inverters with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels. Label with engraved nameplates.

1.6 WARRANTY

- A. Include labor allowance required for replacement on-site at no extra cost to the Owner within 1-year construction warranty. Transfer remainder of the manufacturer's warranty including ballast manufacturer's labor stipend to owner after 1-year construction warranty.
- B. Ballast and Driver Warranty: 5-year replacement warranty.
- C. Emergency Battery Warranty: 3-year pro-rated warranty.
- D. LED System Warranty: 5-year replacement warranty.

- E. Special Warranty: Manufacturer agrees to repair or replace components of pole(s) and luminaires that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within a 5-year warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Luminaires and Poles: Subject to compliance with requirements, provide one of the products indicated for each designation in the Luminaire and Site Luminaire Schedules on the drawings.

2.2 LUMINAIRE AND LUMINAIRE COMPONENTS, GENERAL

- A. Metal Parts: Free from burrs, sharp corners, and edges.
- B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit re-lamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during re-lamping and when secured in operating position.
- D. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated.
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
 - 4. Laminated Silver Metallized Film: 90 percent.
- E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.
 - 1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
 - 2. Lens Thickness: 0.125 inch (3 mm) minimum, unless greater thickness is indicated.
- F. Finishes: Manufacturer's standard, unless otherwise indicated.
 - 1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
 - 2. Metallic Finish: Corrosion resistant.

2.3 LED LIGHT SOURCES

- A. LED Light Source Requirements:
 - 1. Rated life (L70): Minimum 50,000 hours as defined by IES LM80 and TM21.
 - 2. Color Rendering Index (CRI): 80 CRI minimum.
 - 3. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

B. LED Driver Requirements:

1. 0-10V Dimming
2. Total Harmonic Distortion Rating: Less than 20 percent.
3. Ambient temperature rating: -40° to +55° C
4. Power Factor (100% output): >0.95
5. Flickering: LED drivers shall conform to IEEE P1789 standards. Alternatively, manufacturers must demonstrate conformance with product literature and testing which demonstrates this performance. Submit % flicker in 1% increments for full range of dimming starting at 500 mA for full output reading. Systems that do not meet IEEE P1789 will not be considered.

2.4 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Basic Electrical Materials and Methods," for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Twin-Stem Hangers: Two, 1/2-inch (12-mm) steel tubes with single canopy arranged to mount a single luminaire. Finish same as luminaire.
- C. Rod Hangers: 3/8-inch minimum diameter, cadmium-plated, threaded steel rod.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Luminaires: Set level, plumb, and square with ceiling and walls. Secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each luminaire.
- C. Align luminaires for optimum directional alignment of light distribution.
- D. Remote Mounting of Ballasts or Drivers: Distance between the ballast/driver and fixture shall not exceed that recommended by manufacturer. Verify wire size and maximum distance between ballast/driver and luminaire with manufacturer.
- E. Support for luminaires in or on Grid-Type Suspended Ceilings:
 1. Utilize grid for support where ceiling system is appropriate rated. Contractor to coordinate luminaire weights with ceiling contractor.
 2. At all other locations install a minimum of two ceiling support system rods or wires for each luminaire. Locate not more than 6 inches (150 mm) from luminaire corners.
 3. Support Clips: Fasten to luminaires and to ceiling grid members at or near each luminaire corner.
 4. Luminaires of Sizes Less Than Ceiling Grid: Arrange as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
- F. Suspended Luminaire Support:
 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.

2. Continuous Rows: Suspend from cable installed according to luminaire manufacturer's written instructions and details on Drawings.
- G. Burn-In: Continuously illuminate (burn-in) lamps per manufacturer's recommendations. Continuously illuminate LED light sources for 100 hours prior to substantial completion.

3.2 CONNECTIONS

- A. Ground equipment: Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.
- B. Ground Metal Poles and Support Structures: Comply with requirements in Section 26 06 00 "Grounding and Bonding."
 1. Install grounding electrode for each pole unless otherwise indicated.
 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
- C. Ground Nonmetallic Poles and Support Structures: Comply with requirements in Section 26 06 00 "Grounding and Bonding."
 1. Install grounding electrode for each pole.
 2. Install grounding conductor and conductor protector.
 3. Ground metallic components of pole accessories and foundation.

3.3 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Provide instruments to make and record test results.
- C. Test as follows:
 1. Verify normal operation of each luminaire after installation.
 2. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation.
 3. Verify normal transfer to battery source and retransfer to normal.
- D. Malfunctioning Luminaires and Components: Replace or repair, then retest. Repeat procedure until units operate properly.
- E. Perform a load-duration test for inverters at rated voltage and rated output current to verify the correct functional operation of the unit under full-load stable operating conditions for the minimum time limits required by UL 924. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 CLEANING AND ADJUSTING

- A. Clean luminaires internally and externally after installation. Use methods and materials recommended by manufacturer.
- B. Perform startup service for inverters. Engage a factory-authorized service representative if recommended by manufacturer or required for warranty. Train Owner's maintenance personnel to adjust, operate, and maintain emergency lighting inverters, and to use and reprogram microprocessor-based control, monitoring, and display functions.

- C. Contractor shall perform initial aiming of luminaires based on information indicated on drawings. Final aiming shall be completed by contractor under direction of engineer. Final aiming shall take place after sun has set and contractor shall make all required accommodations to access luminaires (lifts, etc.) - coordinate exact time with engineer.

END OF SECTION 26 51 00

APPENDIX A
GEOTECHNICAL REPORT

September 29, 2025

Westside Community Schools
c/o Mr. Matt Herzog
Project Advocates
Project Representative for Westside Community Schools Foundation
1313 Cuming Street, Suite 200
Omaha, Nebraska 68102

RE: Report of Geotechnical Exploration
Westside Community Schools
High School Cooling Tower Addition
8701 Pacific Street
Omaha, Nebraska
TD2 Job No.: 2421-171

Mr. Herzog,

This letter will serve as the Report of Geotechnical Exploration performed at the above noted location based on our written agreement with you acting as the owner's representative. This investigation was made to determine soil conditions for a proposed commercial cooling tower addition at the project site. The purpose of the geotechnical exploration work is to obtain soil samples at the site of the proposed commercial building addition project for laboratory testing and engineering recommendations to furnish detailed information on subsurface conditions for use in final design.

The proposed cooling tower unit is approximately 100,000 pounds. An enclosure around the cooling tower will be needed for security. The interior courtyard of the enclosure is anticipated to be a concrete slab-on-grade. The cooling tower is expected to be placed on a mat foundation with shallow bearing.

One (1) soil boring was advanced in the approximate footprint of the proposed cooling tower. A Boring Location Plan is attached. Boring B-1 was advanced to a depth of 33.5 feet below the existing ground surface. The boring was intended to be advanced to a depth of 35 feet, but after encountering free ground water at about 15 feet, the bore hole sloughed between drilling auger removal and sampling equipment placement. Samples were generally able to be collected through the sloughing, except at the final sampling depth of 33.5 feet. At that depth, the sloughing collapse extended to about 20 feet below grade, precluding collecting of the final planned sample.

The current site surface is generally landscaped grass covered. It appears that this area has been landscaped grassed since very early in the Westside High School building's life. A tennis court has been just south of the cooling tower area also for a significantly long time but has experienced repaving in the past. In this landscaped area, several current small trees are present, But several larger trees were historically present. These trees are expected to have been planted and not volunteers. The historical trees were removed, but for unknown reasoning.

This site lies within the loess hills of eastern Nebraska. The typical soil profile in this region consists of various ages of loess deposits overlying glacial deposits. Peoria and Loveland loess materials are derived from wind borne sediments developed from the historic floodplain of the Missouri River following the last regional glaciation. These sediments are cemented together with various calcium-based compounds. Peoria loess is a younger deposit consisting of a larger fraction of silts. Loveland loess is an older deposit consisting of a larger clay fraction and exposed to differing weather conditions. Loess deposits typically conform to the topography of the underlying eroded glacial till surface. The glacial till materials are composed of a nonhomogeneous mixture of clays, silts, sands, and gravels deposited during the advancing and retreating of the last regional glaciation. More specifically, the site lies within a historic upland drainage way. Entrenched drainage ways such as this can contain various recently deposited materials that are found overlying the loess or in some cases completely replacing it. Soils named Alluvium are deposited during and after floods and flood events. Soil materials named Colluvium were deposited by local wash and creep slough from adjacent uplands. Limestone, shale, and/or sandstone bedrock are typically found at depth in the area.

The USDA Web Soil Survey identifies the natural near surface soils at the site mapped as Urban land-Udorthents-Pohocco complex, 0 to 16 percent slopes (9720). This mapping suggests that the natural near surface soils have been obscured by man's activities, including the placement of fills.

The 1975 Soil Survey of Douglas and Sarpy Counties identifies the natural near surface soils mapped as Monona silt loam, 7 to 11 percent slopes (MoD). This mapping suggests the natural near surface soils formed in loess materials.

The soil encountered in the boring included topsoil overlying colluvium consisting of silts and clays at the ground surface and overlying Peoria loess soils consisting of silts and clays. The detailed boring logs are attached. The following is a brief review of the various layers of soil encountered in the boring. The boring encountered topsoil at the immediate ground surface. About 4 inches of topsoil was observed.

Colluvium was encountered underlying the topsoil in the boring. The Colluvium was described as light brown to dark brown to brown, moist to wet, and firm to very stiff. Visual classification of this material generally suggested Lean Clay (CL) according to the Unified Spoil Classification System (USCS). Laboratory analysis of the recovered Colluvium samples yielded moisture contents from 14.7 to 32.6 percent, dry unit weights from 84.4 to 96.9 pounds per cubic foot, and unconfined compressive strengths from 0.06 to 1.08 tons per square foot.

Peoria loess was encountered underlying the colluvium. The boring was terminated in the Peoria loess. The Peoria loess was described as yellowish dark brown, very moist to wet, and very soft. Visual classification of this material generally suggested Lean Clay (CL) according to the USCS. Laboratory analysis of the recovered Peoria loess samples yielded moisture contents from 36.0 to 37.2 percent and dry unit weights from 78.4 to 79.3 pcf.

Free ground water was encountered during and after the drilling operations in the boring. During drilling operations free water was encountered at 15 feet below the ground surface. The borings were left open after drilling operations and extended water levels were measured prior to abandoning the borings. After drilling operations free water was measured at 33.5 feet below ground surface in the boring.

Free ground water is not expected to be encountered within the depth of anticipated footings or shallow site utility excavations. It should be noted that groundwater levels may fluctuate seasonally and yearly from the readings noted on the boring logs. Factors affecting groundwater levels can include precipitation, flow direction, nearby pumping, and temperature changes.

Soil properties for the site have been assumed to be consistent with those identified in the boring samples. However, variations may be present but unknown. The following recommendations are based on the soil conditions encountered and our experience.

Prior to construction and fill placement, any topsoil, vegetative cover and root crown should be grubbed and stripped from cut and fill areas. The exposed grade should be lightly scarified and blended with the first fill lift to eliminate a shear zone between the two layers. All fill material should be placed in thin, loose horizontal lifts and thoroughly moisture conditioned and compacted. Compaction of all the fill placed is necessary to minimize post-construction compression (settlements) of the fill. Loose lift thickness should be adjusted based on the compactor size but should not exceed about 12 inches. Compaction requirements for cohesive fills should be referenced to the ASTM D1557 (Modified Proctor) test method. Fill should be compacted to at least 90 percent of the maximum density at a moisture content from -1 to +5 percent of the optimum moisture content. Significant new fills (defined as >4') are not anticipated to be needed to provide a level building pad. Should significant fills become needed, the geotechnical engineer should be allowed to review the fill heights with respect to potential settlement under the fill.

The expected on-site materials are expected to be of a clayey nature. Therefore, compaction is expected to be best accomplished by a sheep's foot type compactor because of its kneading effect during compaction. Any compaction effort is more effective when the soil is at the optimum moisture content. Moisture conditioning should be completed before placement and compaction. Flooding to impart compaction should not be allowed. The laboratory results suggest that the on-site low plastic soils are expected to be suitable as fill material following processing and moisture conditioning. High plastic or Fat Clay soils should not be used for fill or backfill. The low plastic loess soils encountered in the borings were generally above optimum moisture content; however, some processing, drying, wetting and/or blending of the on-site soils may be necessary prior to compaction.

Imported fill may be needed for use as fill, backfill, or a blending or replacement material. Imported fill should be a Lean Clay (CL) according to the USCS, exhibit a liquid limit less than 43 and a plasticity index less than 23, be free of organics, debris, particles larger than 1½", and other deleterious materials.

Backfill for shallow utilities and immediately behind below grade walls should be compacted to an in-place dry unit weight at least 85 percent of the maximum dry unit weight at a water content at the time of compaction to within -1 and +6 percent of the optimum water content. Backfill placed with a zone of subgrade preparation should be compacted to the requirements of the subgrade for the full depth of the backfill.

Based on the encountered soil properties, it is recommended that a combined mat foundation element be used to support the cooling tower and enclosure walls on a common foundation instead of using continuous wall foundation elements and slab-on-grade. In this manner the entire mat foundation can be relied upon to act as a foundation element. The soils encountered are not considered suitable to support the mat foundation system. Furthermore, the existing site soils are frost susceptible, so embedment to a frost free depth would be necessary. A solution is to use an overexcavation of the soil under the mat foundation, and somewhat beyond it, and replace it with a frost free material that would be suitable to increase the support for the mat and provide required frost protection.

In this case, the overexcavation should be made to at least 3 feet below the bottom of the mat foundation. The overexcavation width should be no less than 18 inches wider than the mat foundation dimension. The overexcavation fill material can be a recycled crushed concrete aggregate, cleaned and screened, with a maximum 1½" particle size. The aggregate should be placed in lifts with compactive effort applied for each lift. Some displacement of the aggregate pieces into the overexcavation base is acceptable. Following this recommended soil improvement, that mat foundation be sized using a net allowable bearing capacity of 1,500 pounds per square foot.

The sides of the overexcavation should be lined with a medium weight, non-woven geotextile fabric to prevent migration of soil fines into the concrete. The fabric should also be wrapped back over the extended width of the aggregate replacement so that final backfills can be placed. A geotextile fabric such as Mirafi 160N or US Fabrics 160 or equivalent is suitable. The base of the overexcavation does not require a geotextile fabric.

Because of the clayey nature of the encountered soils, it is expected that overexcavation may be trench formed. The mat foundation would require forming due to the extension of the overexcavation. The overexcavation should be completed with a smooth edge bucket excavator to reduce bearing surface disturbance. During overexcavation, care should be exercised to avoid overexcavating below the grade required by the plans. It is not recommended that fill be placed at the base of the overexcavation.

Total settlements are expected to be less than about 1 inch, with differential settlements less than ¾ inch over 25 feet. These estimates are anticipated to be within tolerable range for the proposed mat foundation construction.

The enclosure walls may act as retaining walls should backfill be placed against them. The lateral earth pressure on the walls is a function of the site grades, backfill material type, backfill compaction, and wall movement. The anticipated soil properties of the site soils used as backfill were used to determine lateral earth pressures. Below grade walls can be designed using the equivalent fluid pressure method. The drained at-rest equivalent fluid pressure should be used as 55 pounds per cubic foot. The drained active equivalent fluid pressure should be used as 45 pounds per cubic foot.

The recommended lateral earth pressures do not include the effect of hydrostatic pressure; therefore, the backfill must be drained. To allow draining of the backfill soils, the drain system should (at the least) be a conventional foundation drain tile system; perforated or slotted pipe set in a granular trench, wrapped in geotextile fabric at footing depth. This will be needed where backfill heights against the walls will be greater than about 5 feet. The system should direct drainage to exterior daylight outlets. Proper slope of the perimeter drain tile of at least 1-inch fall over 10 feet will aid in promoting drainage through the system. Daylight outlets should be located such that the drain line run has a positive slope to promote drainage. At a minimum, below grade portions of walls should have a conventional spray applied damp proofing. As free ground water is not expected within 4 feet of the bearing level of the mat foundation, an interior drain tile system is not expected to be necessary.

Passive pressure can be used for resistance of lateral loads for portions of the footings or grade beams more than 12 inches below the slab subgrade or exterior grade. Passive resistance should only be used with trench formed footings or formed footings that have been backfilled to the requirements of Structural Fill. The drained allowable passive equivalent fluid pressure should be used as 150 pounds per cubic foot. Friction against the footing bearing surface can also be used in resisting lateral soil loads and may be determined by using normal dead loads and an allowable friction coefficient of 0.32 when on the overexcavation aggregate fill. Surcharge loads should be transformed to an equivalent height of soil weighing 115 pounds per cubic foot to determine the lateral earth pressure on the wall.

Steps to protect the final soil grade immediately adjacent to the structure from surface erosion and moisture content changes will significantly reduce potential risks of undesirable differential settlements. Additionally, during construction, the exposed grades may be susceptible to saturation, runoff, and erosion. Effective precautions to slow runoff and reduce erosion will be needed. Protection of the slope should be provided until sufficient ground cover is established to minimize erosion.

Final landscape grading of the area should consider the overall flow of water around the structure, as well as runoff from and towards the adjacent lot areas. Paved surfaces of the site should be sloped at least 1 percent to promote runoff. Other non-paved areas should consider a minimum slope of 3 percent. Immediately next to foundations. Surface grading should be maintained away from the structure. Immediately adjacent to structure elements, a minimum slope of 1 inch per foot for the first 5 to 10 feet is recommended.

Following construction, replacement of removed topsoil over lawn and landscape areas of the site should be performed. Proper attention should be given to replacement of topsoil, especially in lawn areas. Final cover should include at least 6 to 8 inches of topsoil to promote grass growth, especially over areas where mineral soil is exposed. If sufficient topsoil cannot be stripped from the site, an imported topsoil should be considered. The topsoil functions to promote growth of the landscape and acts as a buffer between the surface and the mineral soil to retard infiltration and potential erosion of the underlying mineral soil.

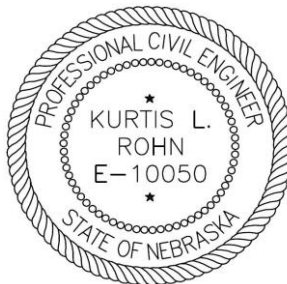
The conclusions and recommendations contained herein are based in part on the soil investigation as described above. Please contact our office if differing conditions become apparent so that we may determine the applicability of these recommendations in light of the conditions encountered. Reliably predicted settlement estimates cannot be made for extraneous causes of settlement such as poor backfill or fill compaction, saturating of subsoils through excessive irrigation, precipitation, or broken piping. Steps to protect the final soil grade immediately adjacent to foundation walls from surface erosion and moisture content changes will significantly reduce potential risks.

Please feel free to contact our office if you have any questions or require additional assistance.

Respectfully submitted,
THOMPSON, DREESSEN & DORNER, INC.



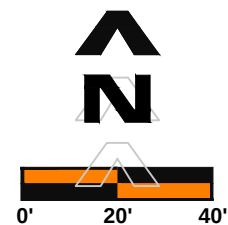
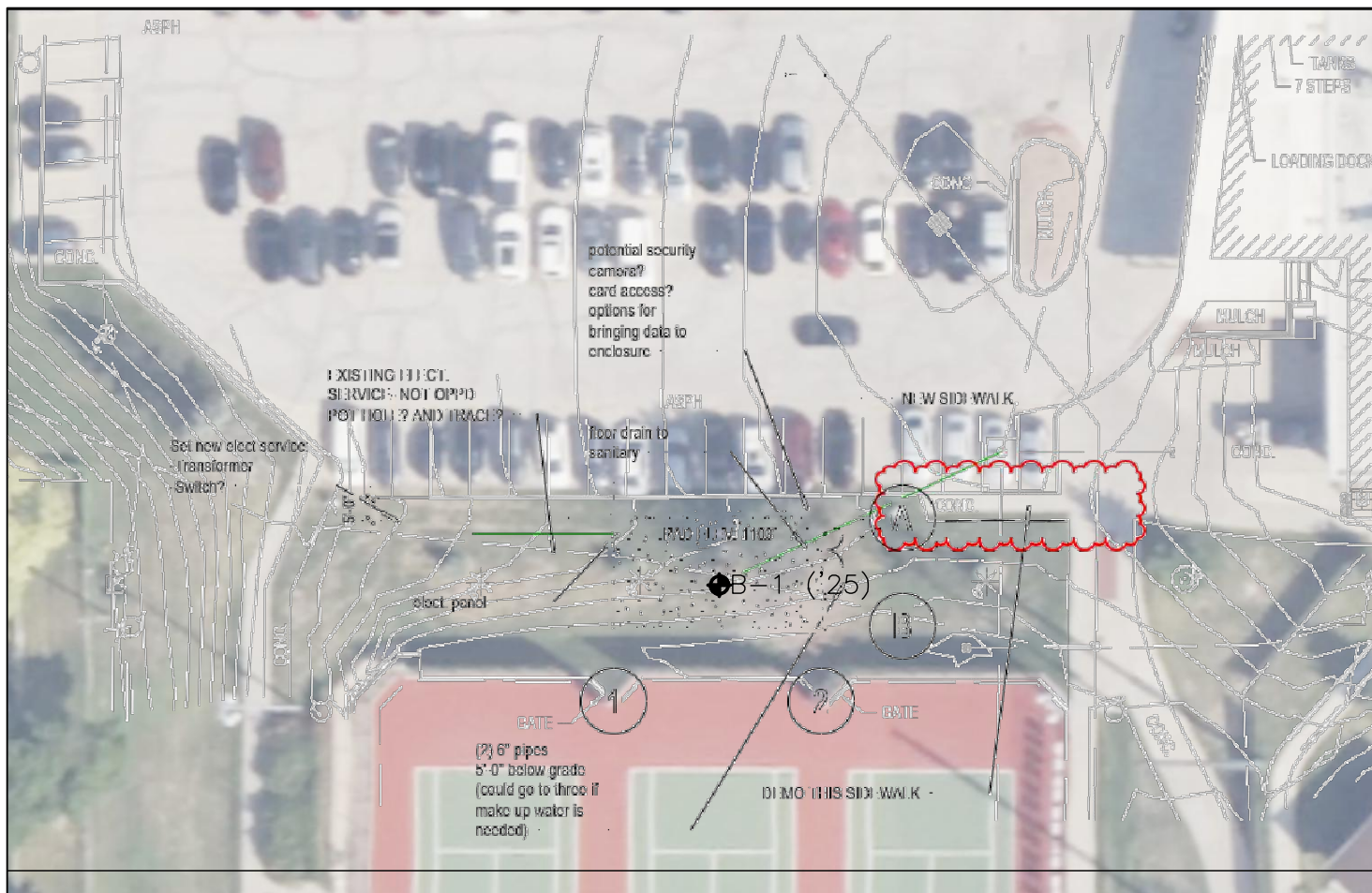
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KLR/alj

Enclosures

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THOMPSON, DREESSEN & DORNER, INC.
Consulting Engineers & Land Surveyors

GEOTECHNICAL ENGINEERING DIVISION

PROJECT: High School Cooling Tower Addition

LOCATION: 8701 Pacific Street, Omaha, NE

CLIENT: Westside Community Schools

JOB NO. : 2421-171

DRILL DATE: 7/24/2025

BORING LOG

BORING NO. : B-1

WEATHER CONDITIONS

BORING LOCATION

SURFACE ELEV.

ELEVATION DATUM

DRILLER

LOGGER

Cloudy 75°

See Boring Location Plan

1103.10

NAVD 88

A. Cannia

W. Nettell

GROUNDWATER LEVEL OBSERVATIONS

TYPE OF SURFACE

SPT HAMMER

DRILL RIG

WHILE
DRILLING

END OF
DRILLING

24 HOURS AFTER
DRILLING

HOURS

Landscaped Grass

NA

CME-45

15.0

33.5

HBED

4" Continuous Flight Auger

Fish

33.5 feet

SAMPLE DATA

DESCRIPTION OF SOIL

LABORATORY RESULTS

DEPTH (ft)	SAMPLE NO. & TYPE	PENETRO- METER STRENGTH (tsf)	SAMPLE REC (%)	COLOR	MOIST	CONS.	USCS	GEOLOGICAL DESCRIPTION	GRAPHICAL LOG	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	q _u (tsf)	SOIL CLASS	DEPTH (ft)
				DK BR	Moist	Stiff	CL	Topsoil, 4"						
	U-1	3.5	100	Light Brown	Moist	Very Stiff	CL	Colluvium,, Lean Clay, Low Plasticity, Slightly Blocky, Root Hairs, Root Holes		14.7	84.4			
5	U-2	1.75	100	Dark Brown		Firm				19.8	86.8	0.47		5
	U-3	2.75	100	Brown						23.1	96.9	1.08		
10	U-4	2.5	100			Stiff		Trace Fine Root Hairs		23.1	91.3	0.74		10
	U-5	0.5	100		Wet	Soft		Rust Stains, and Rust Halos		32.5	93.0	0.06	LL=36 PI=15 CL	15
	U-6	1.25	100			Firm		Some collapse slough in boring at sampling depth, but able to sample through Rust Stains, Rust Lined Root Channels		32.6	90.2	0.16		20
25	U-7	0.25	100	Yellowish Dark Brown	Wet	Very Soft	CL	Peoria loess, Lean Clay, Low Plasticity, Slightly Layered, Rust Stains Some collapse slough in boring at sampling depth, but able to sample through		37.2	78.4			25
30	U-8	< 0.25	100					Some collapse slough in boring at sampling depth, but able to sample through		36.0	79.3			30



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CLIENT: Westside Community Schools

JOB NO. : 2421-171

DRILL DATE: 7/24/2025

BORING LOG

BORING NO. : B-1 Cont'd

WEATHER CONDITIONS

BORING LOCATION

SURFACE ELEV.

ELEVATION DATUM

DRILLER

LOGGER

Cloudy 75°

See Boring Location Plan

1103.10

NAVD 88

A. Cannia

W. Nettell

GROUNDWATER LEVEL OBSERVATIONS

TYPE OF SURFACE

SPT HAMMER

DRILL RIG

WHILE
DRILLING

END OF
DRILLING

24 HOURS AFTER
DRILLING

HOURS

Landscaped Grass

NA

CME-45

DRILLING METHOD

BIT USED

TOTAL DEPTH

15.0

33.5

HBED

4" Continuous Flight Auger

Fish

33.5 feet

SAMPLE DATA

DESCRIPTION OF SOIL

LABORATORY RESULTS

DEPTH (ft)	SAMPLE NO. & TYPE	PENETRO- METER STRENGTH (tsf)	SAMPLE REC (%)	COLOR	MOIST	CONS.	USCS	GEOLOGICAL DESCRIPTION	GRAPHICAL LOG	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	q _u (tsf)	SOIL CLASS	DEPTH (ft)
				Yellowish Brown	Wet	Very Soft	CL	Peoria loess, Lean Clay, Low Plasticity						
								Hole collapsed to 20' at sampling depth, unable to recover sample through. Abandoned boring.	☒					
								Bottom of Boring @ 33.5'						

SOIL BORING LOGS

Water Level Observations: Water level observations were made under the conditions noted in the open, uncased bore holes. Fluctuations in the water levels may occur with time, precipitation, and other factors.

Samples: Samples types are identified by letter and by consecutive number within a boring:

U	Thin-walled tube sample.
S	Split spoon sample.
A	Auger disturbed sample obtained from auger cuttings.
CC	Continuous core sample from Macro Core® sampler.
RC	Rock core sample.

N-Blows per Foot: Resistance as measured while performing the Standard Penetration Test. The number indicates blows for the last 12 inches of penetration of the split spoon sampler. Multiple numbers indicate blows per 6 inches of penetration or blows per length driven.

Recovery: Recovery is shown as a ratio of inches of sample recovered to inches of sample attempted.

Penetrometer Strength: The hand penetrometer resistance in tons per square foot determined in the field for the recovered sample.

Physical Description: The description includes color, moisture condition, consistency, and Unified Soil Classification System description. The USCS description is either interpreted or determined as noted. Includes other pertinent comments from field observations.

Geologic Description: A brief geologic interpretation and observations of the recovered samples and/or exposed cuttings.

Graphical Log: The symbols suggest the observed variations in the geologic formations or soils layers showing similar attributes. The soil boring log Geologic Description contains detailed descriptions. A symbol legend follows the soil boring logs.

Laboratory Results: Brief summary of selected laboratory results. A separate Summary of Soil Testing Results provides more complete information.

Limitations: The profiles indicated on the logs are an idealized description of the subsurface soil materials based on the observations of the recovered samples. The boundary lines shown represent approximate boundaries between material types and the actual changes may be gradual.

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES (Based on Unified Soil Classification System) ASTM: D 2487

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A				Soil Classification				
				Group Symbol	Group Name ^B			
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	Gravels (More than 50% of coarse fraction retained on No. 4 sieve)	Clean Gravels (less than 5% fines ^C)	$Cu \geq 4$ and $1 \leq Cc < 3$ ^D	GW	Well-graded gravel ^E			
			$Cu < 4$ and/or $[Cc < 1$ or $Cc > 3]$ ^D	GP	Poorly graded gravel ^E			
		Gravels with Fines (more than 12% fines ^C)	Fines classify as ML of MH	GM	Silty gravel ^{E, F, G}			
			Fines classify as CL or CH	GC	Clayey gravel ^{E, F, G}			
	Sands (50% or more of coarse fraction passes No. 4 sieve)	Clean Sands (less than 5% fines ^H)	$Cu \geq 6$ and $[1 < Cc < 3]$ ^D	SW	Well-graded sand ^I			
			$Cu < 6$ and/or $[Cc < 1$ or $Cc > 3]$ ^D	SP	Poorly graded sand ^I			
		Sands with Fines (more than 12% fines ^H)	Fines classify as ML or MH	SM	Silty sand ^{F, G, I}			
			Fines classify as CL or CH	SC	Clayey sand ^{F, G, I}			
		Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	Inorganic	$PI > 7$ and plots on or above "A" line ^J	CL	Lean clay ^{K, L, M}	
					$PI < 4$ or plots below "A" line ^J	ML	Silt ^{K, L, M}	
				Organic	Liquid limit (oven dried)	< 0.75	OL	Organic clay ^{K, L, M, N}
					Liquid limit (not dried)		Organic silt ^{K, L, M, O}	
Silts and Clays Liquid limit 50 or more	Inorganic		PI plots on or above "A" line	CH	Fat clay ^{K, L, M}			
			PI plots below "A" line	MH	Elastic silt ^{K, L, M}			
	Organic		Liquid limit (oven dried)	< 0.75	OH	Organic clay ^{K, L, M, P}		
			Liquid limit (not dried)		Organic silt ^{K, L, M, Q}			
Highly organic soils		Primarily organic matter, dark in color, and organic odor		PT	Peat			

^A Based on the material passing the 3-in. (75-mm) sieve

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to the group name

^C Gravels with 5 to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay

$$Cu = \frac{D_{60}}{D_{10}} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^E If soil contains $\geq 15\%$ sand, add "with sand" to group name

^F If fines classify as CL-ML, use dual symbol GC-GM or SC-SM

^G If fines are organic, add "with organic fines" to group name

^H Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay

^K If soil contains 15 to $<30\%$ plus No. 200, add "with sand" or "with gravel", whichever is predominant

^L If soil contains $\geq 30\%$ plus No. 200, predominantly sand, add "sandy" to group name

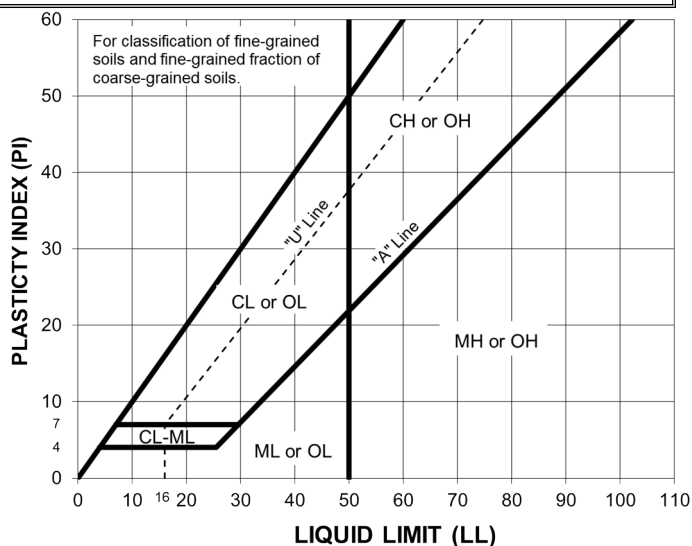
^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name

^N $PI \geq 4$ and plots on or above "A" line

^O $PI < 4$ or plots below "A" line

^P PI plots on or above "A" line

^Q PI plots below "A" line



SUMMARY OF SOIL TEST RESULTS

PROJECT: High School Cooling Tower Addition

JOB NO: 2421-171

CLIENT: Westside Community Schools

DATE: 7/28/2025

LOCATION: 8701 Pacific Street

Omaha, NE

Page 1 of 1

BORING No.	SAMPLE NO.	SAMPLE DEPTH	SAMPLE DIAM.	SAMPLE LENGTH	MOISTURE CONTENT	DENSITY WET	DENSITY DRY	VOID RATIO	SAT. (%)	UNCONFINED COMPRESSION		SOIL CLASSIFICATION					REMARKS
												ATTERBERG LIMITS			GROUP SYMBOL	PASSING #200 (%)	
										qu (tsf)	STRAIN (%)	LL	PL	PI			
B-1	U-1	1-2.5	2.78	5.05	14.7	96.7	84.4	0.982	40								
	U-2	3.5-5	2.79	5.46	19.8	104.0	86.8	0.927	57	0.47	1.3						
	U-3	7-8.5	2.84	5.84	23.1	119.2	96.9	0.726	85	1.08	2.7						
	U-4	8.5-10	2.81	5.74	23.1	112.4	91.3	0.832	75	0.74	2.1						
	U-5	13.5-15	2.81	5.82	32.5	123.3	93.0	0.798	100	0.06	1.5	36	21	15	CL		
	U-6	18.5-20	2.86	5.86	32.6	119.6	90.2	0.855	100	0.16	1.4						
	U-7	23.5-25	2.97	5.81	37.2	107.5	78.4	1.134	88								
	U-8	28.5-30	2.95	5.77	36.0	107.8	79.3	1.110	87								



THOMPSON, DREESSEN & DORNER, INC.
Consulting Engineers & Land Surveyors

GEOTECHNICAL ENGINEERING DIVISION

CONSOLIDATION TEST RESULTS

PROJECT: High School Cooling Tower Addition

JOB NO: 2421-171

CLIENT: Westside Community Schools

DATE: 7/29/2025

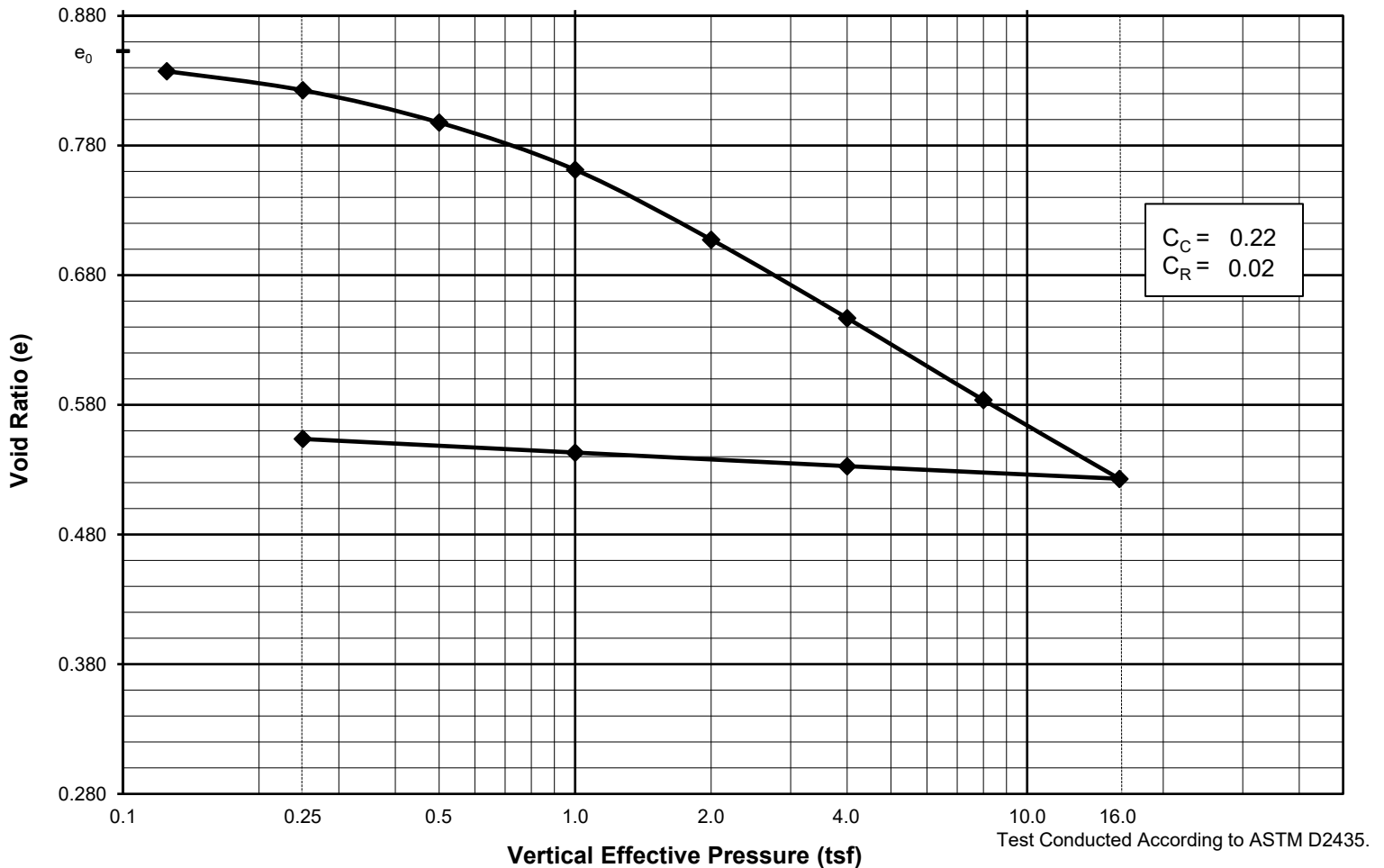
LOCATION: 8701 Pacific Street

Omaha, NE

SAMPLE ID: B-1 U-5

SAMPLE DEPTH: 13.5-15

SAMPLE DESCRIPTION: Brown, Lean Clay, Low Plasticity, Colluvium



Overburden Stress 0.83 tsf

Preconsolidation Stress 0.80 tsf

ATTERBERG LIMITS

LL = 36 PI = 15 Classification = CL

Specific Gravity = 2.68 (Assumed)

TEST DATA

Initial Water Content 30.8 %

Wet Unit Weight 123.3 pcf

Dry Unit Weight 94.3 pcf

Initial Void Ratio 0.853

Initial Saturation 100.0 %

Final Water Content 20.8 %



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