

SECTION 00 0101
PROJECT TITLE PAGE

OWNER:

Johnson County Conservation
Kent Park, 2048 Hwy 6 NW
Oxford, IA 52322

PROJECT NUMBER: 2250000910

PROJECT LOCATION:

Kent Park Campground
2048 US-6 NW Oxford,
Iowa 52322

ARCHITECT/ENGINEER:

Shive-Hattery, Inc.
4125 Westown Parkway, Suite 100
Des Moines, IA 50266

BIDS DUE:

February 12, 2026
3:00 PM
Kent Park – Administrative Office, 2048 Highway 6 NW
Oxford, IA 52322

NON-MANDATORY PREBID MEETING:

January 28, 2026
10:00 AM - 12:00 PM
Kent Park - Conservation Education Center, 2048 US-6 NW
Oxford, IA 52322

ISSUED FOR:

Issued for Bid January 23, 2026

END OF SECTION

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SECTION 00 0105**CERTIFICATIONS PAGE****STATE OF IOWA**

	I hereby certify that the portion of this technical submission described below was prepared by me or under my direct supervision and responsible charge. I am a duly Licensed Architect under the laws of the State of Iowa. Printed or typed name: Richard Cleaveland _____ Signature Date License Expires: 06/30/2026 Pages, Sheets, or Divisions covered by this Seal: Divisions 08, 10, 13
	I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa. _____ Signature Date Printed or typed name: Daniel Jensen License Number: P25063 My license renewal date is: 12/31/2025 Pages, Sheets, or Divisions covered by this Seal: Divisions 00, 01
	I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa. _____ Signature Date Printed or typed name: Jessica Dooley License Number: P27051 My license renewal date is: 12/31/2026 Pages, Sheets, or Divisions covered by this Seal: Divisions 22, 23; M, P Sheets

	I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa. _____ Signature Date Printed or typed name: Matthew Gordon License Number: 19216 My license renewal date is: 12/31/2026 Pages, Sheets, or Divisions covered by this Seal: Divisions 26, 27; E Sheets
	I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Landscape Architect under the laws of the State of Iowa. _____ Signature Date Printed or typed name: Garret Munch License Number: LA00779 My license renewal date is: 06/30/2027 Pages, Sheets, or Divisions covered by this Seal: Division 32

END OF SECTION

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Project # 2250000910

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**SECTION 00 0115
LIST OF DRAWING SHEETS**

SEE DRAWINGS COVER SHEET G000.

END OF SECTION

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SECTION 00 1113

ADVERTISEMENT FOR BIDS

PROJECT: SHOWER HOUSE F.W. KENT PARK

BIDS DUE: February 12, 2026 at 3:00 PM

TO:

THE Owner (HEREINAFTER REFERRED TO AS Owner):

Johnson County Conservation

Kent Park, 2048 Hwy 6 NW

Oxford, IA 52322

Architect (hereinafter referred to as Architect/Engineer):

Shive-Hattery, Inc.

4125 Westown Parkway, Suite 100

Des Moines, IA 50266

NON-MANDATORY PREBID MEETING:

DATE: January 28, 2026

TIME: 10:00 AM - 12:00 PM

LOCATION: Kent Park - Conservation Education Center, 2048 US-6 NW Oxford, IA 52322

TO: POTENTIAL BIDDERS

Sealed bids will be received by the Owner at Kent Park – Administrative Office, 2048 Highway 6 NW, Oxford, IA 52322 until 3:00 PM, Central Time, on February 12, 2026.

Sealed bids will be opened and publicly read at the Kent Park – Administrative Office, 2048 Highway 6 NW, Oxford, IA 52322 at 3:05 PM, Central Time, on February 12, 2026 or at such later time and place as may then be fixed.

Bids will be considered by the Owner at the March 5, 2026 Johnson County Conservation Board Meeting, at the Johnson County Administration Building, First Floor Room 120, 913 South Dubuque Street, Iowa City, Iowa 52240 at 5:30 PM, Central Time, or at such later time and place as may then be fixed.

The general nature of the work is as follows:

Construction of foundations, utilities, mechanical systems, electrical systems, rooftop solar array, a prefabricated precast concrete shower house. The shower house will consist of eight (8) stalls and space for mechanical and electrical equipment. It will be heated and cooled using geothermal systems.

Shower House F.W. Kent Park
Project # 2250000910

The work must commence in March 2026 and must reach Substantial Completion by June 16, 2026 and Final Completion on July 3, 2026.

Bidding documents may be examined online at and at the following location(s):

Rapids Reproductions, DFS Plan Room, Shive-Hattery Custom Portal, rapidsrepro.com
6015 Huntington Ct. NE, Cedar Rapids, IA 52402
Master Builders of Iowa mbionline.com, 221 Park Street, Des Moines, IA 50309
mbiplanroof-dsm@mbionline.com

Copies of the Bidding documents may be obtained by Bidders and Subbidders from Rapids Reproductions (rapidsrepro.com) in accordance with the Instructions to Bidders upon depositing the sum of fifty dollars (\$50.00) for each set of documents. A Master Builders card may be presented in place of a deposit. The deposit will be refunded in full upon return of the documents in good condition within fourteen days after award of project.

Each Bidder shall accompany the Bid with a Bid security, in a separate envelope, as security that the successful bidder will enter into a contract for the work bid upon and will furnish after the award of the contract corporate surety bond or bonds, acceptable to the Owner, for the faithful performance of the contract, in an amount equivalent to one hundred percent of the amount of the contract. The bidder's security shall be in an amount equivalent to 5% of the bid amount, and shall be in the form of a cashier's or certified check drawn on a bank in Iowa or a bank chartered under the laws of the United States of America, or a certified bank share draft drawn on a credit union in Iowa or chartered under the laws of the United States of America or a bid bond with corporate surety satisfactory to the Owner. The bid security will be held by the Owner until a contract is fully executed and bonds are approved by the Owner.

No bid may be withdrawn for a period of 30 days after the date of the scheduled closing time for the receipt of bids.

It is the intent of the Owner to award a contract to the lowest responsible, responsive bidder provided the bid has been submitted in accordance with the bidding requirements. The Owner reserves the right to waive informalities or irregularities. The Owner reserves the right to reject any or all bids.

Published by order of the Johnson County Conservation Board of Oxford, IA.

Publish: By no later than No later than January 23, 2026
Submit your offer on the Bid Form provided. Bidders may supplement this form as appropriate.

END OF SECTION

**SECTION 00 1115
NOTICE OF PUBLIC HEARING**

SHOWER HOUSE F.W. KENT PARK

JOHNSON COUNTY CONSERVATION

To Whom It May Concern:

You are hereby notified that at 5:30 PM, Central Time on January 22, 2026, at the Johnson Administration Bldg., 1st Floor, Betty Sass Room, 913 South Dubuque Street, Iowa City, IA 52240, there will be a public hearing on the proposed plans, specifications, form of contract, and estimated cost of the project. Any persons interested may appear and file objections to the proposed plans, specifications, form of contract, or cost of such improvement.

The following is a description of the Public Improvement: Construction of foundations, utilities, mechanical systems, electrical systems, rooftop solar array, a prefabricated precast concrete shower house. The shower house will consist of eight (8) stalls and space for mechanical and electrical equipment. It will be heated and cooled using geothermal systems.

The location of the project is as follows:

Kent Park Campground
2048 US-6 NW
Oxford, IA 52322

Proposed drawings, specifications, form of contract and estimated total cost for consideration at the public hearing will be available by January 21, 2026 at the Johnson County Auditor's Office, 913 South Dubuque Street, First Floor, Iowa City, IA 52240 or at the office of the Johnson County Conservation Board, Operations Center, 2048 US-6 NW, Oxford, IA 52322. Approved bid documents will be available at www.rapidsreproplanroom.com beginning January 23, 2026.

Published by order of the Johnson County Conservation Board, Oxford, Iowa.

Publish: No later than January 17, 2026

END OF SECTION

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**SECTION 00 2113
INSTRUCTIONS TO BIDDERS**

SUMMARY

AIA Document AIA A701 Instructions to Bidders, is the Instructions to Bidders and is hereby made a part of these Documents to the same extent as if bound herein. This form can be purchased from the American Institute of Architects State Office as follows:

AIA Iowa

400 Locust Street, Suite 100

Des Moines, IA 50309

Phone: 515-244-7502

Fax: 515-244-5347

www.aiaiowa.org

Refer to Document 00 2115 Supplementary Instructions to Bidders for additions and amendments to these Instructions to Bidders.

END OF SECTION

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**SECTION 00 4000
PROCUREMENT FORMS AND SUPPLEMENTS**

PART 1 GENERAL

1.1 FORMS

- A. Use the following forms for the specified purposes unless otherwise indicated elsewhere in the procurement requirements.
- B. Instructions to Bidders: AIA A701.
- C. Substitution Request Form (During Procurement): 00 4325 - Substitution Request Form.
- D. Substitution Request Form (During Construction): 00 6325 - Substitution Request Form - During Construction.
- E. Bid Form: Section 00 4100 - Bid Form.
- F. Procurement Form Supplements:
 - 1. Bid Security Form: AIA 310-2010 "Bid Bond".
- G. Representations and Certifications:
 - 1. Bidder's Status Form: 00 4100.01.
 - 2. Authorization to Transact Business: 00 4100.02
 - 3. Non-Collusion Affidavit: 00 4100.03.

1.2 REFERENCE STANDARDS

- A. AIA A310 - Bid Bond; 2010.
- B. AIA A701 - Instructions to Bidders; 2018.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 00 4100

BID FORM

PROJECT: SHOWER HOUSE F.W. KENT PARK

BID TO:	JOHNSON COUNTY CONSERVATION
	KENT PARK, 2048 HWY 6 NW
DELIVER BID TO:	KENT PARK – ADMINISTRATIVE OFFICE, 2048 HIGHWAY 6 NW
	OXFORD, IA 52322

SUBMITTED BY: _____

(BIDDER TO ENTER NAME AND ADDRESS).

BIDDER'S FULL NAME _____

ADDRESS _____

CITY, STATE, ZIP _____

BIDDER EMAIL ADDRESS _____

NOTE: Submit one original of this Bid Form. All blanks shall be completed. Only bids on this form will be accepted. Submit Bid Security, if required, in separate envelope. Bidder shall carefully review the Instructions to Bidders and Supplementary Instructions to Bidders prior to completing this form.

1. The undersigned BIDDER proposes and agrees, if this Bid is accepted, to enter into an agreement with OWNER in the form included in the Contract Documents to perform and furnish all Work as specified or indicated in the Contract Documents for the Bid Price and within the schedule indicated in this Bid and in accordance with the other terms and conditions of the Contract Documents. Bidder accepts all of the terms and conditions of the Advertisement for Bids and Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 30 days after the day of Bid opening.
2. The undersigned Bidder submits, herewith, bid security in accordance with the terms set forth in the Advertisement for Bids and Supplementary Instructions to Bidders.
3. The Bidder has examined and carefully studied the Bidding Documents and the following Addenda, receipt of all which is hereby acknowledged:

<u>DATE</u>		<u>NUMBER</u>

4. BIDDER has visited the site and become familiar with and is satisfied as to the general, local and site conditions that may affect cost, progress, performance and furnishing of the Work.
5. BIDDER is familiar with and is satisfied as to all federal, state and local Laws and Regulations that may affect cost, progress, performance and furnishing of the Work.

Shower House F.W. Kent Park
Project # 2250000910

6. BIDDER will complete the Work in accordance with the Contract Documents per Section 00 4201 Schedule of Bid Prices.

Lump Sum Bid Price		\$
(use words)		
	Civil, Site, Utilities & Landscaping	\$
	Precast Concrete Shower House Building	\$
	Electrical	\$
	Solar	\$
	Structural Foundations	\$
	Mechanical and Plumbing	\$

7. BIDDER agrees that the Work will be completed in accordance with the project schedule in the Advertisement for Bids.

8. BIDDER accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the Work within the times specified in the Agreement.

9. Bidder certifies that this proposal is made in good faith, without collusion or in connection with any other person, organization, or corporation bidding on the work.

10. The following documents are attached to and made a condition of this Bid:

a. Required Bid Security in the amount of _____ and in the form of _____.
SUBMITTED IN A SEPARATE ENVELOPE.

b. 00 4100.01 - Bidder Status Form, 00 4100.02 - Authorization to Transact Business Worksheet, and 00 4100.03- Non-Collusion Affidavit.

11. This Bid submitted on _____, 20____.

12. State Contractor License No. _____.

13. The bidder shall not make any revisions to the bid forms or the Schedule of Bid Prices and shall not devise any alternates other than those provided. Any such notes, revisions, or comments shall be grounds for rejection of the bid as not being responsive.

14. Complete the applicable item(s) listed below. If this Bid is submitted by an agent of BIDDER, attach a current Power-of-Authority certifying the agent's authority to bind the BIDDER.

IF BIDDER IS:

An Individual

By: _____

(signature of individual) (typed or printed name)

doing business as: _____

Business Address: _____

Phone No. _____

A Partnership

By: _____

(Firm Name)

(signature of general partner) (typed or printed name)

Business Address: _____

Phone No. _____

A Corporation

By: _____

(Corporation Name)

State of Incorporation: _____

By: _____

(signature of person authorized to sign)

(typed or printed name and title)

Attest: _____

(Secretary)

Business Address: _____

Phone No. _____

END OF SECTION

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**SECTION 00 4100.01
BIDDER STATUS FORM**

To be completed by all bidders	Part A
Please circle Yes or No for each of the following:	

Part 1 Bidder Status Form

1.1 IOWA BIDDER STATUS FORM

- A. The Iowa Division of Labor Bidder Preference Law is required by Iowa Code 73A.21. and can be referenced here: <http://www.iowadivisionoflabor.gov/bidder-preference-law>

1. Iowa Bidder Status Form

YES	NO	My company is authorized to transact business in Iowa
		<i>(To help you determine if your company is authorized, please review the worksheet on the next page).</i>
YES	NO	My company has an office to transact business in Iowa.
YES	NO	My company's office in Iowa is suitable for more than receiving mail, telephone calls, and e-mail.
YES	NO	My company has been conducting business in Iowa for at least 3 years prior to the first request for bids on this project.
YES	NO	My company is not a subsidiary of another business entity or my company is a subsidiary of another business entity that would qualify as a resident bidder in Iowa.
		If you answered "Yes" for each question above, your company qualifies as a resident bidder. Please complete Parts B and D of this form.
		If you answered "No" to one or more questions above, your company is a nonresident bidder. Please complete Parts C and D of this form.

Shower House F.W. Kent Park
Project # 2250000910

To be completed by resident bidders

Part B

My company has maintained offices in Iowa during the past 3 years at the following addresses:

Dates: ____/____/____ to ____/____/____ Address: _____

City, State, Zip: _____

Dates: ____/____/____ to ____/____/____ Address: _____

City, State, Zip: _____

Dates: ____/____/____ to ____/____/____ Address: _____

City, State, Zip: _____

You may attach additional sheet(s) if needed.

To be completed by non-resident bidders

Part C

- 1. Name of home state or foreign country reported to the Iowa Secretary of State:**

- 2. Does your company's home state or foreign country offer preferences to bidders who are residents? (Circle one)** **YES** **NO**

- 3. If you answered "Yes" to question 2, identify each preference offered by your company's home state or foreign country and the appropriate legal citation.**

You may attach additional sheet(s) if needed.

To be completed by all bidders

Part D

I certify that the statements made on this document are true and complete to the best of my knowledge and I know that my failure to provide accurate and truthful information may be a reason to reject my bid.

Firm name: _____

Signature: _____ **Date:** _____

You must submit the completed form to the government body requesting bids per 875 Iowa Administrative Code Chapter 156. This form has been approved by the Iowa Labor Commissioner.

END OF SECTION

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**SECTION 00 4100.02
AUTHORIZATION TO TRANSACT BUSINESS WORKSHEET**

This worksheet may be used to help complete Part A of the Resident Bidder Status form. If at least one of the following describes your business, you are authorized to transact business in Iowa. Circle Yes or No.

YES	NO	My business is currently registered as a contractor with the Iowa Division of Labor.
YES	NO	My business is sole proprietorship & I am an Iowa resident for Iowa income tax purposes.
YES	NO	My business is a general partnership or joint venture. More than 50 percent of the general partners or joint venture parties are residents of Iowa for Iowa income tax purposes.
YES	NO	My business is an active corporation with the Iowa Secretary of State & has paid all fees required by the Secretary of State, has filed its most recent biennial report, & has not filed articles of dissolution.
YES	NO	My business is a corporation whose articles of incorporation are filed in a state other than Iowa, the corporation has received a certificate of authority from the Iowa secretary of state, has filed its most recent biennial report with the secretary of state, & has neither received a certificate of withdrawal from the secretary of state nor had its authority revoked.
YES	NO	My business is a limited liability partnership which has filed a statement of qualification in this state & the statement has not been canceled.
YES	NO	My business is a limited liability partnership which has filed a statement of qualification in a state other than Iowa, has filed a statement of foreign qualification in Iowa & a statement of cancellation has not been filed.
YES	NO	My business is a limited partnership or limited liability partnership which has filed a certificate of limited partnership in this state, & has not filed a statement of termination.
YES	NO	My business is a limited partnership or a limited liability limited partnership whose certificate of limited partnership is filed in a state other than Iowa, the limited partnership or limited liability limited partnership has received notification from the Iowa secretary of state that the application for certificate of authority has been approved & no notice of cancellation has been filed by the limited partnership or the limited liability limited partnership.

Shower House F.W. Kent Park
Project # 2250000910

YES	NO	My business is a limited liability company whose certificate of organization is filed in Iowa & has not filed a statement of termination.
YES	NO	My business is a limited liability company whose certificate of organization is filed in a state other than Iowa, has received a certificate of authority to transact business in Iowa & the certificate has not been revoked or canceled.

END OF SECTION

SECTION 00 4100.03

NON-COLLUSION AFFIDAVIT

The undersigned bidder or agent, being duly sworn on oath, says that he/she has not, nor has any other member, representative, or agent of the firm, company, corporation or partnership represented by him, entered into any combination, collusion or agreement with any person relative to the price to be bid by anyone at such letting nor to prevent any person from bidding nor to include anyone to refrain from bidding, and that this bid is made without reference to any other bid and without any agreement, understanding or combination with any other person in reference to such bidding.

He/She further says that no person or persons, firms, or corporation has, have or will receive directly or indirectly, any rebate, fee gift, commission or thing of value on account of such sale.

OATH AND AFFIRMATION

I HEREBY AFFIRM UNDER THE PENALTIES FOR PERJURY THAT THE FACTS AND INFORMATION CONTAINED IN THE FOREGOING BID FOR PUBLIC WORKS ARE TRUE AND CORRECT.

Dated this _____ day of _____, _____.

Name of organization: _____

Title of person signing: _____

Signature: _____

ACKNOWLEDGEMENT

STATE OF _____)

COUNTY OF _____)

Before me, a Notary Public, personally appeared the above named and swore that the statements contained in the foregoing document are true and correct.

SUBSCRIBED AND SWORN TO ME THIS _____ DAY OF _____,

Notary Public Signature: _____

My Commission Expires: _____

END OF SECTION

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SECTION 00 4325

SUBSTITUTION REQUEST FORM

REFERENCE: AIA A701 INSTRUCTIONS TO BIDDERS SUBPARAGRAPH 3.3

NOTE: SUBSTITUTION REQUESTS MUST BE RECEIVED BY THE Architect/Engineer NO LATER THAN FEBRUARY 9, 2026 BY 5:00 PM.

PROJECT: Shower House F.W. Kent Park

A/E: Shive-Hattery, Inc.

BIDDER: _____

BY: _____

DATE: _____

SPECIFIED MATERIAL, PRODUCT OR EQUIPMENT: _____

RELATED SPECIFICATION SECTIONS: _____

RELATED DRAWING NUMBERS: _____

PROPOSED SUBSTITUTION: _____

REASON FOR PROPOSED SUBSTITUTION:

ATTACHED DATA: Refer to AIA Instructions To Bidders (AIA A701-1997) subparagraph 3.3 Substitutions for requirements. Attach additional pages, if necessary.

<u>Item No.</u>		<u>Description</u>

For Use by the Architect/Engineer

Substitution:	☐	Approved	☐	☐	Not Approved
	☐	Approved As Noted	☐	☐	Not Approved - Received too Late

By: _____ Date: _____

END OF SECTION

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**SECTION 00 5000
CONTRACTING FORMS AND SUPPLEMENTS**

PART 1 GENERAL

- 1.1 WHERE IT IS PROVIDED IN THE BID DOCUMENTS THAT THE CONTRACTOR SHALL USE AIA DOCUMENTS, THEY ARE HEREBY MADE A PART OF THESE DOCUMENTS TO THE SAME EXTENT AS IF BOUND HEREIN. AIA FORMS MAY BE PURCHASED FROM THE AMERICAN INSTITUTE OF ARCHITECTS AT WWW.AIA.ORG.
- 1.2 AGREEMENT AND CONDITIONS OF THE CONTRACT
- A. See Section 00 5200 - Agreement Form for the Agreement form to be executed.
 - B. See Section 00 7200 - General Conditions for the General Conditions.
 - C. See Section 00 7300 - Supplementary Conditions for the Supplementary Conditions.
 - D. The Agreement is based on AIA A101.
 - E. The General Conditions are based on AIA A201.
- 1.3 FORMS
- A. Use the following forms for the specified purposes unless otherwise indicated elsewhere in Contract Documents.
 - B. Bond Forms:
 - 1. Bid Bond Form: AIA A310.
 - 2. Performance and Payment Bond Form: AIA A312.
 - C. Post-Award Certificates and Other Forms:
 - 1. Application for Payment Forms: AIA G702 with AIA G703 (for Contractors).
 - D. Clarification and Modification Forms:
 - 1. Request for Interpretation Form: Contractor-created form (PDF).
 - 2. Substitution Request Form (During Construction): Section 00 6325.
 - 3. Architect's Supplemental Instructions Form: Architect-created form (PDF).
 - 4. Construction Change Directive Form: AIA G714.
 - 5. Proposal Request Form: Architect-created form (PDF).
 - 6. Change Order Request Form: Contractor-created form (PDF).
 - 7. Change Order Form: AIA G701.
 - E. Closeout Forms:
 - 1. Certificate of Substantial Completion Form: AIA G704.
 - 2. Affidavit of Payment of Debts and Claims Form: AIA G706.
 - 3. Affidavit of Release of Liens Form: AIA G706A.
 - 4. Consent of Surety to Final Payment Form: AIA G707.

1.4 REFERENCE STANDARDS

- A. AIA A101 - Standard Form of Agreement Between Owner and Contractor where the basis of Payment is a Stipulated Sum; 2017.
- B. AIA A201 - General Conditions of the Contract for Construction; 2017.
- C. AIA A310 - Bid Bond; 2010.
- D. AIA A312 - Performance Bond and Payment Bond; 2010.
- E. AIA G701 - Change Order; 2017.
- F. AIA G702 - Application and Certificate for Payment; 1992.
- G. AIA G703 - Continuation Sheet; 1992.
- H. AIA G704 - Certificate of Substantial Completion; 2017.
- I. AIA G709 - Proposal Request; 2018.
- J. AIA G710 - Architect's Supplemental Instructions; 2017.
- K. AIA G714 - Construction Change Directive; 2017.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 00 5200
AGREEMENT FORM**

CHECKLIST:

PART 1 GENERAL

2.1 FORM OF AGREEMENT

- A. AIA A101-2017 "Standard Form of Agreement Between Owner and Contractor", where the basis of payment is a stipulated Sum, forms the basis of the contract between the Owner and Contractor and is hereby made a part of these Documents to the same extent as if bound herein. All provisions which are not amended or supplemented remain in full force and effect.
- B. This form can be purchased from the American Institute of Architects state office as follows:
 - 1. AIA Iowa
 - 2. 400 Locust Street, Suite 100
 - 3. Des Moines, IA 50309
 - 4. Phone: 515-244-7502
 - 5. Fax: 515-244-5347
 - 6. www.aiaiowa.org

2.2 RELATED REQUIREMENTS

- A. Section 00 7200 - General Conditions.
- B. Section 00 7300 - Supplementary Conditions.
- C. Section 01 4216 - Definitions.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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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 _____ of _____ in the year
Two Thousand Twenty-Six
(In words, indicate day, month and year.)

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

Johnson County Conservation Board
FW Kent Park 2048 US-6 NW
Oxford, IA 52322
319-645-2315

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

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

Shower House F.W. Kent Park
Kent Park Campground 2048 US-6 NW
Oxford, IA 52322

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

Shive-Hattery, Inc.
4125 Westown Parkway, Ste 100
West Des Moines, IA 50266
515.223.8104

The Owner and Contractor agree as follows.

ADDITIONS AND DELETIONS:

The author of this document may have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added to or deleted from the original AIA text.

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

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.

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

TABLE OF ARTICLES

- 1 THE CONTRACT DOCUMENTS
- 2 THE WORK OF THIS CONTRACT
- 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION
- 4 CONTRACT SUM
- 5 PAYMENTS
- 6 DISPUTE RESOLUTION
- 7 TERMINATION OR SUSPENSION
- 8 MISCELLANEOUS PROVISIONS
- 9 ENUMERATION OF CONTRACT DOCUMENTS

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.

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.)

- ☐ The date of this Agreement.
- ☐ A date set forth in a notice to proceed issued by the Owner.
- ☒ Established as follows:
(Insert a date or a means to determine the date of commencement of the Work.)
- March 2026

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: June 19, 2026

Final Completion of the entire Work:

[X] By the following date: July 2, 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

§ 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

§ 4.3 Allowances, if any, included in the Contract Sum: (Identify each allowance.)

Item	Price

§ 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.)

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

§ 4.5 Liquidated damages, if any:

(Insert terms and conditions for liquidated damages, if any.)

Time is of the essence on this contract. Contractor and Owner Recognize that the Owner will suffer financial and other losses if work is not completed within the time specified in section 3.3.1, plus extension thereof allowed in accordance with the contract. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by the Owner if the Work is not completed on time. Accordingly, instead of requiring and such proof, Owner and Contractor agree that as liquidated damages for delay, but not a penalty:

1. Substantial completion: Contractor shall pay owner five hundred dollars (\$500.00) for each day that expires after the time (as duly adjusted pursuant of the Contract) specified in Section 3.3.1 above for Substantial Completion

- until the work is substantially complete.
2. Completion of Remaining Work: After substantial completion, if contractor shall neglect, refuse, or fail to complete the remaining work within the contract time (As duly adjusted pursuant of the Contract) for completion and readiness for final payment, Contractor shall pay owner five hundred dollars (\$500.00) for each day that expires after the time until the work is complete and ready for final payment.
 3. Liquidated Damages for failing to timely attain Substantial Completion and Final Completion are not additive and will not be imposed concurrently.
 4. After Contractor achieved Substantial Completion, if contractor shall neglect, refuse, or fail to complete the remaining work within the contract time, Contractor shall reimburse Owner for the actual costs reasonably incurred by owner for engineering, construction observation, inspection, and administrative services needed after the time specified in Section 3.3.1 for Work to be completed and ready for final payment (as duly adjusted pursuant to the Contract), until the Work is completed and ready for final payment.

§ 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 Provided that an Application for Payment is received by the Architect not later than the Second Tuesday of a month, the Owner shall make payment of the amount certified to the Contractor not later than the last day of the same 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 sixty (60) 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:

§ 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.

§ 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.)

Three Percent (3.0%)

§ 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.)

N/A

§ 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.)

Retainage may be reduced in accordance with the Supplementary Conditions and the laws of the State of Iowa as applicable.

§ 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 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 the Contractor's responsibility to correct Work as provided in Article 12 of AIA Document A201–2017, and to satisfy other requirements, if any, which extend beyond final payment; and
- .2 a final Certificate for Payment has been issued by the Architect.

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

1. The Contractor has fully performed the Contract except for the Contractor's responsibility to correct work provided in Article 12 of AIA Document A201–2017, and to satisfy other requirements, if any, which extend beyond final payment; and
2. A final Certificate of Payment has been issued by the Architect.

§ 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.)

A rate equal to the rate specified by rule pursuant of Iowa Code Section 74A.2 or Iowa Code Section 573.14, whichever is less.

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

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 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)*

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.)

N/A

§ 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)

Brad Freidhof
FW Kent Park2048 US-6 NW
Oxford, IA 52322
319-645-2315
bfreidhof@johnsoncountyiowa.gov

§ 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 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 a building information modeling exhibit, if completed, or as otherwise set forth below:

(If other than in accordance with a building information modeling exhibit, 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.)

N/A

§ 8.7 Other provisions:

Section 00 5350 Insurance Requirements
Section 00 7300 Supplementary Conditions

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
- .2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds
- .3 AIA Document A201™–2017, General Conditions of the Contract for Construction
- .4 Building information modeling exhibit, dated as indicated below:
(Insert the date of the building information modeling exhibit incorporated into this Agreement.)

- .5 Drawings

Number
39 Sheets

Title
Shower House F.W. Kent
Park

Date
2026-01-21

- .6 Specifications

Section	Title	Date	Pages
All	Project Manual	2026-01-21	496

.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
00 7300	Supplementary Conditions	2026-01-21	16

.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)

**SECTION 00 5350
INSURANCE REQUIREMENTS**

SECTION I

1.1 BASIC INSURANCE REQUIREMENTS

- A. Contractor, at its own expense, shall procure and maintain during the life of this Contract, the following insurance so as to cover all risk which shall arise directly or indirectly from Contractor's obligations and activities.
- B. The Contractor is required to purchase and maintain insurance coverage to protect the Contractor and Johnson County throughout the duration of this Contract as enumerated above in the minimum limits above written and the requirement shall be a part of the Contract. Failure on the part of the Contractor to maintain this insurance in full effect will be treated as a failure on the part of the Contractor to comply with these requirements and be considered sufficient cause to suspend the work, withhold payment(s), and/or be disqualified in the future.

1.2 GENERAL LIABILITY INSURANCE

- A. Contractor shall carry the most recently approved ISO Commercial General Liability Insurance policy, or its equivalent, written on an occurrence-basis, with limits not less than \$1,000,000 per occurrence / \$2,000,000 general aggregate for Bodily Injury and Property Damage, including the following coverages:
 - 1. Premises
 - 2. Contractual Liability
 - 3. Products and Completed Operations Coverage
 - 4. Broad Form Property Damage Liability, including Explosion, Collapse, and Underground coverages; an elimination of the exclusions with respect to property under the care, custody or control of Contractor (or, in lieu of elimination of the exclusion, Contractor may provide Builder's Risk or Installation Floater coverage for property under the care, custody, or control of Contractor); and Independent Contractor Coverage.
 - 5. Personal Injury Liability

1.3 AUTOMOBILE LIABILITY INSURANCE

- A. Automobile liability insurance with a combined single limit of at least \$1,000,000 per occurrence for bodily injury and property damage. Coverage shall include all owned, hired, and non-owned motor vehicles used in the performance of this contract by the Contractor or its employees.

1.4 WORKERS COMPENSATION AND EMPLOYERS LIABILITY INSURANCE

- A. Meet the relevant Workers Compensation Statutes.

1.5 A COPY OF ONE (1) ENDORSEMENT IS REQUIRED:

A. Cancellation and Material Changes Endorsement

1. Thirty (30) days Advance Written Notice of Cancellation, Non-Renewal, Reduction in insurance coverage and/or limits and ten (10) days written notice of non-payment of premium shall be sent to:

Brad Freidhof, Executive Director
2048 Hwy 6 NW
Oxford, IA 52322
Email: BFreidhof@JohnsonCountyIowa.gov

Please note that JCCB does accept a signed letter on the agent's letterhead, from the insured's insurance agent, confirming that the agent will provide notice as indicated above.

1.6 ADDITIONAL INSURED ENDORSEMENT

- A. Johnson County, Iowa, including all its elected and appointed officials, all its employees and volunteers, all its boards, commissions and/or authorities and their board members, employees, and volunteers, are included as Additional Insured with respect to liability arising out the Insured's work and/or services performed for Johnson County, Iowa. This coverage shall be primary to the Additional Insured and not contributing with any other insurance or similar protection available to the Additional Insureds, whether available coverage be primary, contributing or excess. JOHNSON COUNTY intends to be an Additional Insured with coverage being primary and not contributing with any other insurance or similar protection available to JOHNSON COUNTY whether any other coverage is primary, contributing or excess. JOHNSON COUNTY may require an endorsement preserving JOHNSON COUNTY's governmental immunities under such coverage. See below.

1. JOHNSON COUNTY, IOWA
2. GOVERNMENTAL IMMUNITIES ENDORSEMENT
3. (for use when including the County as an Additional Insured)
4. Nonwaiver of Government Immunity. The insurance carrier expressly agrees and states that the purchase of this policy and the including of Johnson County, Iowa as Additional Insured does not waive any of the defenses of governmental immunity available to Johnson County, Iowa under Code of Iowa Section 670.4 as it now exists and as it may be amended from time to time.
5. Claims Coverage. The insurance carrier further agrees that this policy of insurance shall cover only those claims not subject to the defense of governmental immunity under the Code of Iowa Section 670.4 as it now exists and as may be amended from time to time.
6. Assertion of Government Immunity. Johnson County, Iowa shall be responsible for asserting any defense of governmental immunity and may do so at any time and shall do so upon the timely written request of the insurance carrier. Nothing contained in this endorsement shall prevent the carrier from asserting the defense of governmental immunity on behalf of Johnson County, Iowa.
7. Non-Denial of Coverage. The insurance carrier shall not deny coverage under this policy and the insurance carrier shall not deny any of the rights and benefits accruing to Johnson County, Iowa under this policy for reasons of governmental immunity unless and until a court of competent jurisdiction has ruled in favor of the defense(s) of governmental immunity asserted by Johnson County, Iowa.

8. No Other Change in Policy. The insurance carrier and Johnson County, Iowa agree that the above preservation of governmental immunities shall not otherwise change or alter the coverage available under the policy."

1.7 BONDING REQUIREMENTS

- A. In addition to bid security provided for elsewhere in this Agreement, Contractor shall procure and furnish:
 1. A performance bond on the part of the Contractor for 100 percent (100%) of the contract price, satisfactory to the Owner, to secure fulfillment of all the Contractor's obligations under this contract.
 2. A payment bond on the part of the Contractor for 100 percent (100%) of the contract price, satisfactory to the Owner, to assure payment as required by law of all persons supplying labor and material in the execution of the work provided for in the contract.
 3. Contractor may use the most current form of American Institute of Architects Document A312, Performance Bond and Labor and Material Payment Bond, fully executed and for the applicable contract amounts, to satisfy 1. and 2., above.

SECTION II

2.1 CONDITIONS OF CONTRACT

- A. The Contractor is required to purchase and maintain insurance coverage to protect the Contractor and JCCB throughout the duration of this Contract as enumerated above in the minimum limits above written and the requirement shall be a part of the Contract. Failure on the part of the Contractor to maintain this insurance in full effect will be treated as a failure on the part of the Contractor to comply with these requirements and be considered sufficient cause to suspend the work, withhold payment(s), and/or be disqualified in the future.
- B. The insurance policies shall be issued by insurers authorized to do business in the State of Iowa and currently having an A.M. Best Rating of "B+" or better. All policies shall be occurrence form. If Professional Liability coverage is written on a claim made policy form, the certificate of insurance must clearly state coverage is claims made and coverage must remain in effect for at least two years after final payment with the Contractor continuing to furnish JCCB certificates of insurance.
- C. The Contractor shall be responsible for deductibles and self-insured retentions in the Contractor's insurance policies. Insofar as there is a deductible for any builder's risk insurance policies or coverage obtained by Owner, the Contractor shall be responsible for any losses or costs associated with such deductible(s).
- D. The Contractor is required to give JCCB notice of any change in coverage, specifically, any reduction in coverage and cancellation of coverage no less than thirty (30) days prior to the effective date of any non-renewal or cancellation of any policies required by the Contract.

END OF SECTION

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**SECTION 00 5350
INSURANCE AND BONDS - A101 EXHIBIT A**

INSURANCE AND BONDS

The following Supplements modify, change, delete from or add to the "Insurance and Bonds," American Institute of Architects (AIA) Document A101 - 2017 Exhibit A. Where any Article, Section or clause or portion thereof of the Exhibit A - Insurance and Bonds is modified or deleted by these Supplementary Conditions, the unaltered portions of that Article, Section, Section or clause or portion thereof shall remain in effect.

ARTICLE A.2 OWNER'S INSURANCE

The following Sections in Article A.2 are either selected, not selected or revised as stated below:

A.2.4.1 Loss of Use, Business Interruption Insurance with policy limit of \$50,000 is selected. Delete the words "and Delay in Completion Insurance,"

A.2.4.2 Ordinance or Law Insurance with policy limit of \$500,000 is selected.

A.2.4.3 Expediting Cost Insurance with policy limit of \$50,000 is selected.

A.2.4.4 Extra Expense Insurance with policy limit of \$50,000 is selected.

A.2.4.5 Civil Authority Insurance is not selected.

A.2.4.6 Ingress/Egress Insurance is not selected.

A.2.4.7 Soft Costs Insurance with policy limit of \$50,000 is selected.

A.2.5.1 Cyber Security Insurance is not selected.

A.2.5.2 Other Insurance is not selected.

ARTICLE A.3 CONTRACTOR'S INSURANCE AND BONDS

The following Sections in Article A.3 are either selected, not selected or revised as stated below:

A.3.1.1 In the last sentence, after the words "Contractor's Commercial General Liability", add the words "Commercial Auto Liability, Pollution coverage, if applicable,"

A.3.1.1 After the last sentence, add the sentence:

Insurance policies required by this insurance section shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least thirty (30) days prior written notice has been given to the Owner and Architect.

Add the following to Section A.3.1.1:

A.3.1.1.1 If this insurance is written on the Comprehensive General Liability policy form, the Certificates shall be on an ACORD form, completed and supplemented in accordance with AIA G715, Instruction Sheet and Supplemental Attachment for an ACORD Certificate of Insurance form.

A.3.1.1.2 The Owner shall provide written notification to the Contractor of the cancellation or expiration of any insurance required by Exhibit A. The Owner shall provide such written notice within five (5) business days of the date the Owner is first aware of the cancellation or expiration, or is first aware that the cancellation or expiration is threatened or otherwise may occur, whichever comes first.

A.3.1.3 In the first sentence, after the words "commercial general liability," add the words "commercial auto liability, pollution coverage, if applicable, and excess or umbrella liability"

A.3.2.1 Add the following A.3.2.1.1 to Section A.3.2.1

A.3.2.1.1 All insurance coverages, except workers compensation, provided by the Contractor under A.3 shall provide for a waiver of subrogation to the Owner, Architect and Architect's consultants, and agents and employees.

A.3.2.2 Replace Section A.3.2.2.1 in its entirety with the following:

A.3.2.2.1 Commercial General Liability insurance for the Project written on an occurrence form with policy limits of not less than one million (\$1,000,000) each occurrence, two million (\$2,000,000) general aggregate (endorsed to apply on a per project basis), and two million (\$2,000,000) aggregate for products-completed operations hazard (maintain for (2) two years after final payment), providing coverage for claims including

A.3.2.2.1 Replace Section A.3.2.2.1.5 in its entirety with the following:

A.3.2.2.1.5 \$250,000 limit for damage to premises rented to Contractor

A.3.2.2.1 Add Sections A.3.2.2.1.6 through A.3.2.2.1.9:

A.3.2.2.1.6 \$10,000 limit on medical expenses on any one person

A.3.2.2.1.7 \$10,000 limit on medical

A.3.2.2.1.8 Contractual liability for personal & advertising injury

A.3.2.2.1.9 Electronic data liability endorsement with limits not less than \$50,000

A.3.2.2.2 Delete Section A.3.2.2.2.4

A.3.2.3 Revise Section A.3.2.3 as follows:

A.3.2.3 Automobile Liability policy limits will be not less than one million (\$1,000,000) per accident.

A.3.2.3 Add to the end of the last sentence "including coverage for pollution liability broaden cover for automobile per CA 9948 and MCS 90 filings if required by law.

A.3.2.4 Revise Section A.3.2.4 as follows:

A.3.2.4 Revise the second sentence in Section A.3.2.4 to read"...Commercial General Liability, Automobile Liability, and Employer Liability..."

A.3.2.6 Employers' Liability policy limits will be not less than one million (\$1,000,000) each accident, one million (\$1,000,000) each employee, and one million (\$1,000,000) policy limit.

A.3.2.8 Policy limits will be not less than two million (\$2,000,000) per claim and two million (\$2,000,000) in the aggregate for Professional Liability insurance.

A.3.2.9 Policy limits will be not less than two million (\$2,000,000) per claim and two million (\$2,000,000) in the aggregate for Pollution Liability insurance.

A.3.2.10 If a Combined Professional Liability and Pollution Liability insurance policy is procured, policy limits will be not less than five million (\$5,000,000) per claim and five million (\$5,000,000) in the aggregate.

A.3.2.11 Policy limits will be not less than one million (\$1,000,000) per claim and two million (\$2,000,000) in the aggregate for maritime liability risks insurance.

A.3.2.12 Policy limits will be not less than one million (\$1,000,000) per claim and one million (\$1,000,000) in the aggregate for manned or unmanned aircraft insurance.

A.3.3.2.2 Railroad Protective Liability Insurance is not required and therefore A.3.3.2.2 is not selected.

A.3.3.2.5 After the word "owned" add the words "and rented".

A.3.3.2.6 Add the following other insurance coverage to A.3.3.2.6:

Should the Contractors subcontractors or its lower tier subcontractor's work involve the moving, lifting, lowering, rigging or hoisting of property or equipment, Subcontractor shall carry Rigger's Liability insurance to insure against physical loss or damage to the property and/or equipment in the amount no less than one million (\$1,000,000).

END OF SECTION

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SECTION 00 6325

SUBSTITUTION REQUEST FORM - DURING CONSTRUCTION

TO: _____

PROJECT: Shower House F.W. Kent Park

OWNER: Johnson County Conservation

A/E: Shive-Hattery, Inc.

BID DATE: _____

We hereby submit for your consideration the following product instead of the specified item for the above project:

DRAWING NO.: _____ DRAWING NAME: _____

<u>SPEC SECT.</u>	<u>SPEC NAME</u>	<u>PARAGRAPH</u>	<u>SPECIFIED ITEM</u>

_____	_____	_____	_____

Proposed Substitution:

Attach complete information on changes to Drawings and/or Specifications which proposed substitution will require for its proper installation.

Submit, with request, all necessary samples and substantiating data to prove equal quality and performance to that which is specified. Clearly mark manufacturer's literature to indicate equality in performance.

CERTIFICATION OF EQUAL PERFORMANCE AND ASSUMPTION OF LIABILITY FOR EQUAL PERFORMANCE

The undersigned states that the function, appearance and quality are equivalent or superior to the specified item.

Submitted by:

Signature:

Title:

Firm: _____

Address: _____

Telephone: _____ Date: _____

Signature shall be by person having authority to legally bind the firm to the above terms. Failure to provide legally binding signature will result in retraction of approval.

FOR USE BY Architect/Engineer:

☐ Accepted ☐ Accepted as Noted ☐ Not Accepted ☐ Received Too Late

Date: _____

Shower House F.W. Kent Park
Project # 2250000910

FILL IN BLANKS BELOW

Does the substitution affect dimensions shown on Drawings? Yes No

If Yes, clearly indicate changes:

Will the undersigned pay for changes to the building design, including engineering and detailing costs caused by the requested substitution? Yes No

If No, fully explain:

What effect does substitution have on other Contracts or other trades?

What effect does substitution have on construction schedule?

Manufacturer's warranties of the proposed and specified items are: _____ Same _____ Different

(Explain on Attachment)

Reason for Request:

Itemized comparison of specified item(s) with the proposed substitution. List significant variations:

Accurate cost data comparing proposed substitution with product specified:

Designation of maintenance services and sources:

(ATTACH ADDITIONAL SHEETS IF REQUIRED)

END OF SECTION

**SECTION 00 7100
CONTRACTING DEFINITIONS**

PART 1 GENERAL

1.1 APPLICABILITY: THESE DEFINITIONS ARE INTEGRAL TO THE AGREEMENT.

1.2 DEFINITIONS - DESIGN-BUILD DOCUMENTS

- A. Contract Documents: As defined in the Conditions of the Contract and as follows:
 - 1. At the time of execution of the Agreement, Contract Documents consist of the following:
 - a. The Agreement and Conditions of the Contract, and other documents listed on the Table of Contents under the heading Contracting Requirements.
 - 2. From time to time after execution of the Agreement, upon approval by the Owner, the following types of documents will be incorporated into Contract Documents:
 - a. Drawings and other documents documenting the design.
 - b. Construction drawings and specifications detailing the execution of the design.
- B. Project Program: The Owner's requirements for size, arrangement, organization, and location of functional spaces, description of space functions, identification of fittings, equipment, and furnishings, description of the physical and environmental requirements for each space, together with a description of the image, goals, or "mission" of the project.

1.3 DEFINITIONS - TIME PERIODS AND MILESTONE DATES

- A. Preliminary Design: The time period during which the design criteria are finalized and preliminary drawings and written descriptions are prepared to illustrate the proposed design of the work or a portion of the work to the Owner, as described in the Conditions of the Contract.
- B. Design Development: The time period during which the form, arrangement, size, and materials of the work or a portion of the work are determined as described in the Conditions of the Contract.
- C. Construction Documents: The time period during which process working drawings, specifications, and other documents describing the work or a portion of the work are prepared in sufficient detail to allow accurate and complete construction.
- D. Construction: The time period from the beginning of work on the project site until final payment as defined by the Conditions of the Contract.
- E. Substantial Completion: The date as defined in the Conditions of the Contract. Date of Substantial Completion is the due date for the following:
 - 1. Design-Builder's complete punchlist of items to be completed.
 - 2. Owner's complete punchlist of items to be completed.
 - 3. Compliance with requirements of governing authorities, for submittals, inspections, and permits.
 - 4. Compliance with Owner's requirements for access to areas occupied by the Owner.

- F. Closeout: The time period during which all details of both construction and commissioning are completed.
 - 1. The Closeout period is the time from Date of Substantial Completion until final payment, both as defined by the Conditions of the Contract.
 - 2. Before and during the Closeout period, the Owner will ascertain whether the completed project complies with Contract Documents.
- G. Occupancy: The time period during which the project is occupied for its intended purpose.
 - 1. The Occupancy period begins at Date of Substantial Completion, as defined by the Conditions of the Contract.
- H. Correction Period: The time period defined by the Conditions of the Contract.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 00 7200

GENERAL CONDITIONS

FORM OF GENERAL CONDITIONS

AIA A201-2017 "General Conditions of the Contract for Construction" is the General Conditions between the Owner and the Contractor and is hereby made a part of these documents to the same extent as if bound herein. The document can be purchased from the American Institute of Architects state office as follows:

AIA Iowa
400 Locust Street, Suite 100
Des Moines, IA 50309
Phone: 515-244-7502
Fax: 515-244-5347
www.aiaiowa.org

RELATED REQUIREMENTS

Section 00 7300 - Supplementary Conditions.

Section 01 4216 - Definitions.

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**SECTION 00 7300
SUPPLEMENTARY CONDITIONS**

ARTICLE 1: GENERAL PROVISIONS

No Supplements

ARTICLE 2: OWNER

2.1 GENERAL

Add the following Clause 2.1.1.1 to Section 2.1.1:

2.1.1.1 The Owner is:

Name:	Johnson County Conservation
Address:	Kent Park, 2048 Hwy 6 NW, Oxford, IA 52322
Telephone:	(319) 645-2315

Add the following Clause 2.1.1.2 to Section 2.1.1:

2.1.1.2 The Owner's Authorized contract Representative is:

Name:	Brad Freidhof
Title:	Executive Director
Address:	Kent Park, 2048 Hwy 6 NW, Oxford IA 52322
Telephone:	319-645-2315
Fax:	n/a
Email:	bfreidhof@johnsoncountyiowa.gov

2.3 INFORMATION AND SERVICES REQUIRED OF THE OWNER

Delete Section 2.3.2 and substitute the following Section 2.3.2:

2.3.2 The "Architect" is defined in this Contract as the Engineer or Architect lawfully licensed to practice architecture or engineering or an entity licensed to lawfully practice architecture or engineering in the jurisdiction where the project is located and identified as such in this Contract and as is referred to throughout the Contract documents as if singular in number. The term "Engineer," "Architect/Engineer," "Engineer/Architect," "Architect's authorized representative," "Engineer's authorized representative," or "Architect/Engineer's authorized representative" shall mean "Architect" as defined in this Section.

Delete Section 2.3.6 and substitute the following Section 2.3.6:

2.3.6 The Owner will furnish the Contractor copies of the Contract Documents returned to Rapids Reproductions for use in execution of the work. The Contractor may purchase additional copies at the cost of reproduction, postage, and handling.

ARTICLE 3: CONTRACTOR

3.2 REVIEW OF CONTRACT DOCUMENTS & FIELD CONDITIONS BY CONTRACTOR

Add the following sentence to the end of 3.2.2:

3.2.2 The Contractor also represents that all Contract Documents for the Project have been examined, including those intended for work of trades not normally performed by the Contractor's own forces, and that it has become thoroughly familiar with all conditions which may pertain to or affect the Work under the Contract.

Add the following Section 3.2.5 to Section 3.2:

3.2.5 The Owner is entitled to reimbursement from the Contractor for amounts paid to the Architect for evaluating and responding to the Contractor's Requests For Information (RFI) that are not prepared in accordance with the Contract Documents or where the requested information is available to the Contractor from a careful study and comparison of the Contract Documents, field conditions, other Owner-provided information, Contractor-prepared coordination drawings, or prior Project correspondence or documentation.

3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

Add the following Sections 3.3.4 and 3.3.5:

3.3.4 The Owner reserves the right to retain ownership to any materials or equipment that is part of the existing facility. If material or equipment is to be removed from the site, the Contractor shall detach such items and before removing from site, obtain permission from the Owner, or his designee, to do so. All items not retained by Owner shall be removed in a proper manner by the Contractor.

3.3.5 The Contractor shall submit to the Owner before construction begins one copy of Material Safety Data Sheets of hazardous substances to be stored on the Owner's premises or incorporated in the performance of this contract. The Contractor shall also keep Material Safety Data Sheets posted at the work site for all substances while these substances are on the Owner's premises. Hazardous substances shall be any substance which is covered by Law (Right to Know Rules).

3.4 LABOR AND MATERIALS

Add the following sentence to the end of 3.4.1:

3.4.1 Work required by the Contract Documents to be performed after working hours or work the Contractor elects to perform after hours shall be included in the Contract Sum.

Add Sections 3.4.4 through 3.4.8:

3.4.4 After the Contract has been executed, the Owner and the Architect will consider a formal request for the substitution of products in place of those specified only under the conditions set forth in the Specifications, Division 01, General Requirements.

3.4.5 By making requests for substitutions based on Subparagraph 3.4.4 above, the Contractor:

1. Represents that the Contractor has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified;
2. Represents that the Contractor will provide the same warranty for the substitution that the Contractor would for the specified product;
3. Certifies that the cost data presented in the substitution request is complete and includes all related costs under this Contract except the Architect/Engineer's review and/or redesign costs, and waives all claims for additional costs related to the substitution which subsequently become apparent; and
4. Will coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects at the Contractor's expense.

3.4.6 The Owner shall be entitled to reimbursement from the Contractor for amounts paid to the Architect for reviewing the Contractor's proposed substitutions and making agreed-upon changes in the Drawings and Specifications resulting from such substitutions.

3.4.7 The Owner shall be entitled to deduct from the Contract Sum amounts paid to the Architect or Architect's Consultants to evaluate the Contractor's proposed substitutions and to make agreed-upon changes in the Contract Documents made necessary by the Owner's acceptance of such substitutions.

3.4.8 The Contractor, and its subcontractors, shall conform to local labor laws of the State in which the project resides. Prior to starting Work, the Contractor shall become familiar with local labor and trade conditions, skilled and unskilled, and shall conform to the local conditions. The Contractor shall consider the availability of labor in the area and import labor as may be required, at the Contractor's expense, to meet the Schedule for the Work.

3.6 TAXES

Delete the language in Section 3.6 and substitute the following Sections:

3.6.1 This Project is exempt from State and local sales and use taxes on sales of building materials and fixtures to construction contractors for incorporation into real estate for governmental bodies of the State of Iowa. The Contractor shall continue to pay sales tax on items that do not become a part of the Project.

3.6.2 The Owner as a designated exempt entity will complete an online application to register this Project with the Iowa Department of Revenue and Finance. The Owner will distribute Tax Exemption Certificates and Authorization Letters to the Contractor and all Subcontractors who have been identified at, or before filing of the Performance Bond.

3.6.3 On or before the time the Performance Bond is filed, the Contractor shall provide a listing to the Owner identifying all Subcontractors. Contractor and Subcontractors shall make copies of the Tax Exemption Certificate and provide a copy to each supplier providing construction material. This Certificate will allow the Contractor and Subcontractors to purchase qualified building materials free from sales tax for the Project. The Tax Exemption Certificate and Authorization Letter have been developed exclusively for this purpose and are applicable only for this specific Project.

3.6.4 If the online registration is not available at the time The Contract is approved by the Owner, the Owner will notify the Contractor, in writing, and the cost of sales tax on all construction materials used for the Project will be added to the Contract Sum. The Contractor shall then submit Form 35-002 to the Owner for Iowa sales/use tax paid.

3.6.5 Payment will be made in accordance with the payment provisions set out in these specifications and the Advertisement for Bids and Notice of Public Hearing. Notwithstanding anything in these specifications and the Advertisement for Bids and Notice of Public Hearing to the contrary, no Final Payment shall be released until Form 35-002 has been filed with the Owner, where applicable, and all lien waivers are on file.

3.6.6 Notwithstanding anything herein to the contrary, Contractor shall file with Owner forms contemplated by the Iowa Code enabling Owner to apply for a refund for any sales or use tax paid in carrying out the work.

3.7 PERMITS, FEES, NOTICES, AND COMPLIANCE WITH LAWS

Delete Section 3.7.5 and substitute the following Section 3.7.5:

3.7.5 If, in the course of the Work, the Contractor knowingly encounters and recognizes human remains, burial markers, archeological 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 and features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence or good faith belief of such existence of such remains or features may be made as provided in Article 15.

Add Clauses 3.7.5.1 through 3.7.5.3 to Section 3.7.5:

3.7.5.1 Contractor responsible for attaining all local permits and DNR Construction Permits.

3.7.5.2 Upon securing building permits, any plan reviews and fees which may be required by the State or Local Jurisdiction Having Authority in which the project resides, such as Fire Alarm and Automatic Sprinkler System, shall be borne by the Contractor.

3.7.5.3 The Contractor is responsible for scheduling inspections related to the performance of its Work and ensuring Work is complete for inspections. The Contractor is responsible for any costs associated with re-inspection caused by Work that is not in accordance with the requirements of the Contract Documents. In addition, the Contractor is responsible for costs associated with Architectural/Engineering services related to evaluation of the deficiencies and development of an acceptable solution.

3.7.5.4 The Owner shall be entitled to deduct from the Contract Sum amounts paid to the Architect/Engineer or Architect/Engineer's Consultants for services related to evaluation of the deficiencies and development of an acceptable solution, including agreed-upon changes in the Contract Documents.

Add the following Section 3.7.6 and associated clauses 3.7.6.1 thru 3.7.6.3:

3.7.6 The State of Iowa, its agencies, and its political subdivisions, including cities, school districts, public partnerships, and public utilities are required by Iowa Code Section 73A.21 to require a reciprocal resident bidder and resident labor force preference.

3.7.6.1 A "Resident Bidder" means a person or entity authorized to transact business in the State of Iowa and having a place of business for transacting business within the state at which it is conducting and has conducted business for at least three years prior to the date of the first advertisement for the public improvement. If another state or foreign country has a more stringent definition of a resident bidder, the more stringent definition is applicable as to bidders from that state or foreign country.

3.7.6.2 A resident bidder shall be allowed a preference as against a nonresident bidder from a state or foreign country other than Iowa if that state or foreign country gives or requires any preference to bidders from that state or foreign country, including but not limited to any preference to bidders, the imposition of any type of labor force preference, or any other form of preferential treatment to bidders or laborers from that state or foreign country. The preference allowed shall be equal to the preference given or required by the state or foreign country in which the nonresident bidder is a resident.

3.7.6.3 If the Contractor is a nonresident bidder, the Contractor is required to specify in the Agreement between the Owner and Contractor whether any preference (as described in 3.7.6.2) is in effect in the nonresident bidder's state or country at the time of this bid and identify the source of the regulation.

3.9 SUPERINTENDENT

Delete Section 3.9.1 and substitute the following Section 3.9.1:

3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site whenever two or more subcontractors are performing the Work. The superintendent's absence from the project site when work is being performed does not relieve the Contractor of any responsibility for correctly performing the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

Add the following Section 3.9.1.1

3.9.1.1 The Contractor shall employ an assistant to the superintendent who shall perform as coordinator for mechanical and electrical Work. The coordinator shall be knowledgeable in mechanical and electrical systems and capable of reading, interpreting, and coordinating Drawings, Specifications, and shop drawings pertaining to these systems and other systems that may affect or be affected by these systems. The coordinator shall assist the Superintendent in arranging space conditions to eliminate interferences between mechanical, electrical, plumbing, structural, architectural, fire protection, and other systems and Work and shall supervise preparation of coordination drawings documenting the spatial arrangements for such systems within restricted spaces. The coordinator shall assist in planning and expediting the proper sequence of delivery and installation of mechanical and electrical equipment, and Owner furnished items if any.

3.10 CONTRACTOR'S CONSTRUCTION AND SUBMITTAL SCHEDULE

Delete the last sentence of Section 3.10.2 so that the Section now reads:

3.10.2 The Contractor promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect'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.

3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

Add the following Section 3.12.11:

3.12.11 The Architect's and its Consultants' review of Contractor's submittals will be limited to examination of an initial submittal and one (1) re-submittal. The Architect's review of additional submittals will be made only with the consent of the Owner after written notification to the Contractor and Owner by the Architect. The Owner shall be entitled to deduct from the Contract Sum amounts paid to the Architect for evaluation of such additional re-submittals.

3.13 USE OF SITE

Add the following Sections 3.13.1 and 3.13.2:

3.13.1 Contractor shall perform the Work so as to cause a minimum of inconvenience to and interruption of the Owner's operations. Any and all interruptions of the operations of the Owner necessary for the performance of the Work shall be noted in the Progress Schedule and the Contractor shall additionally give the Owner sufficient advanced written notice of such interruption as to allow the Owner to adjust operations accordingly. Contractor's failure to give the Owner timely written notice of such intentions shall place the responsibility of any resulting delays or additional costs solely with the Contractor.

3.13.2 The Contractor, any subcontractor, supplier, vendor or anyone else for whom the Contractor is responsible, shall not bring on the site any asbestos, PCB's, petroleum, hazardous waste or radioactive materials, except for proper use in performing the Work.

3.14 CUTTING AND PATCHING

Delete Section 3.14.1 and replace with the following:

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. Contractor shall be responsible for cutting and patching not specifically indicated on the drawings, but required for completion of their Work. No structural member shall be cut unless approved by the Architect or Architect's Consultants. 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.

ARTICLE 4: ARCHITECT

4.1 GENERAL

Add the following clause 4.1.1.1 to section 4.1.1:

4.1.1.1 The Architect is:

Name:	Shive-Hattery, Inc.
Address:	4125 Westown Parkway, Suite 100
Phone:	574-401-7165
Project Contact Person:	Christina Correll, Project Coordinator
Contact Person Email:	ccorrell@shive-hattery.com

4.2 ADMINISTRATION OF THE CONTRACT

Add Clause 4.2.2.1 to Section 4.2.2:

4.2.2.1 The Owner is entitled to reimbursement from the Contractor for amounts paid the Architect for site visits made necessary by the fault of the Contractor or by defects and deficiencies in the Work. The Owner shall be entitled to deduct from the Contract Sum amounts paid to the Architect for such site visits.

Add the following sentence to the end of Section 4.2.13:

4.2.13 The term aesthetic effect includes, but is not limited to color, texture, profile, and relationship of masses.

ARTICLE 5: SUBCONTRACTORS

5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

Delete Section 5.2.1 and substitute with the following Section 5.2.1:

5.2.1 Unless otherwise stated in the Contract Documents, the Contractor, within seven (7) calendar days after award of the contract and prior to execution 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. After receipt of the information the Architect may notify the contractor within seven (7) calendar days whether or not the Owner or the Architect, after due investigation, (1) has reasonable objection to any such proposed person or entity, or (2) requires additional time and/or information to complete the review. Failure of the Architect to reply within this time period shall constitute notice of no reasonable objections.

ARTICLE 6: CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

No Supplements

ARTICLE 7: CHANGES IN THE WORK

7.1 GENERAL

Add the following Section 7.1.4 and associated clauses 7.1.4.1 thru 7.1.4.9:

7.1.4 The combined overhead and profit included in the total cost to the Owner of a change in the Work shall be based on the following schedule:

7.1.4.1 For the Contractor, for Work performed by the Contractor's own forces, 15 percent of the cost.

7.1.4.2 For the Contractor, for Work performed by the Contractor's Subcontractors, 5 percent of the amount due the Subcontractors.

7.1.4.3 For each Subcontractor involved, for Work performed by that Subcontractor's own forces, 15 percent of the cost.

7.1.4.4 For each Subcontractor involved, for Work performed by the Subcontractor's Sub-subcontractors, 5 percent of the amount due the Sub-subcontractor.

7.1.4.5 The maximum allowable combined overhead and profit passed through to the Owner under any circumstances shall be a maximum of 25 percent.

7.1.4.6 Cost to which overhead and profit is to be applied shall be determined in accordance with Section 7.3.4.

7.1.4.7 In order to facilitate checking of quotations for extras or credits, all proposals, except those so minor that their property can be seen by inspection, shall be accompanied by a complete itemization of costs including labor, materials, and subcontracts. Itemize labor by trade, tasks, hour quantities and labor rates. Itemize materials by product, quantity and unit price. Where major cost items are subcontracts, they shall be itemized also. In no case will a change involving over \$500 be approved without such itemization.

7.1.4.8 The Contractor represents that proposals will include all related costs prior to presentation to the Owner or Architect for consideration.

7.1.4.9 The Architect's review of the Contractor's proposals will be limited to one initial submittal and one re-submittal. The Owner is entitled to obtain reimbursement from the Contractor for amounts paid to the Architect for evaluation and response to additional re-submittals, wherein the first two submittals were not prepared in accordance with the Contract Documents.

7.2 CHANGE ORDERS

Add the following Section 7.2.2:

7.2.2 The forms used to process a Change Order will include AIA Document AIA G701, Change Order.

ARTICLE 8: TIME

8.1 DEFINITIONS

Delete Section 8.1.4 and substitute the following Section 8.1.4:

8.1.4 The term "Day" as used in the Contract Documents shall mean working day, excluding weekends and legal holidays.

8.2 PROGRESS AND COMPLETION

8.2.2 Delete the word "knowingly" in the first sentence.

8.2.3 Revise the end of the sentence after "Substantial Completion" as follows:

"...and Final Completion within the Contract Times specified."

ARTICLE 9: PAYMENTS AND COMPLETION

9.3 APPLICATION FOR PAYMENT

Delete Section 9.3.1 and substitute the following Section 9.3.1:

(For governmental bodies in Iowa, including the State, Counties, Cities, School Districts, etc.)

9.3.1 At least 30 (thirty) days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment for operations completed in accordance with the schedule of values. 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. If the Contract Documents require the Owner to retain a portion of the payments until some future time, the Applications for Payment shall clearly state the percentage and the amount to be retained.

(For private non-governmental entities:)

Add the following sentence to Section 9.3.1:

9.3.1 The form of Application for Payment shall be a notarized current edition of AIA Document AIA G702, Application and Certification for Payment, supported by current edition of AIA Document AIA G703, Continuation Sheet.

Add the following Clause 9.3.1.3 to Section 9.3.1:

9.5 DECISIONS TO WITHHOLD CERTIFICATION

Delete Section 9.5.4 in its entirety.

9.6 PROGRESS PAYMENTS

Delete Section 9.6.1 and substitute the following Section 9.6.1:

9.6.1 After the Architect has issued a Certificate for Payment and the Owner has approved the Application for Payment the Owner shall make payment in the manner provided in the contract Documents and in accordance with Iowa Code Chapters 26 and 573, latest edition.

Delete the first two sentences of Section 9.6.4 so that it reads as follows:

9.6.4 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.

9.8 SUBSTANTIAL COMPLETION

Add the following clause to Section 9.8.1:

9.8.1 Additionally all building systems are complete and operating properly, building and site elements are safe to occupy with no existing safety hazards and ADA, code, life safety requirements met. Building components are secure, doors and windows are lockable as required, security systems are fully functional, and remaining punchlist items will impose no undo hardship, obstruction, inconvenience, or sacrifice to the occupants during their completion.

Add the following Clause 9.8.3.1 to Section 9.8.3:

9.8.3.1 The Architect will perform no more than one (1) inspection to determine whether the Work or a designated portion thereof has attained Substantial Completion in accordance with the Contract Documents. The Owner is entitled to reimbursement from the Contractor for the amounts paid to the Architect for any additional inspections.

9.10 FINAL COMPLETION AND FINAL PAYMENT

Add the following Clause 9.10.1.1 to Section 9.10.1:

9.10.1.1 The Architect will perform no more than one (1) inspection to determine whether the Work or a designated portion thereof has attained Final Completion in accordance with the Contract Documents. The Owner is entitled to reimbursement from the Contractor for the amounts paid to the Architect for any additional inspections.

Delete Section 9.10.2 and substitute the following Section:

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 substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment and (5), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien. If such lien remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees.

Add the following Section 9.10.6:

9.10.6 Final payment will be made no less than thirty (30) days after the date of acceptance of the Work by the Owner subject to the provisions of Sections 9.10.1 through 9.10.5. The following documents shall be completed by the contract completion date listed on the Form of Agreement and shall be received prior to making final payment:

- 1) Building Permit(s)
- 2) Certificate of Occupancy
- 3) Affidavits
- 4) Warranties
- 5) Lien Waivers
- 6) Record Drawings
- 7) Operation & Maintenance manuals

Add the following Section 9.10.7 and Clauses 9.10.7.1 thru 9.10.7.4:

9.10.7 The following clauses are in accordance with Iowa Code, Chapter 26, Section 26.13, Early Release of Retainage, and are reiterated here for reference. Other provisions of Chapter 26, Chapter 573, and other applicable Chapters of the Code also apply:

9.10.7.1 At any time after all work on the project is substantially completed, the Contractor may request the release of all or part of the retained funds owed. The request shall be accompanied by a sworn statement of the Contractor that, ten (10) calendar days prior to filing the request, notice was given as required by Section 7 (of Chapter 26) to all known subcontractors, sub-subcontractors and suppliers.

9.10.7.2 Except as provided under Section 3 (of Chapter 26), upon receipt of such request, the Owner shall release all or part of the retained funds. Retained funds that are approved as payable shall be paid at the time of the next monthly payment or within 30 days, whichever is sooner. If partial retained funds are released pursuant to a Contractor's request, no retained funds shall be subsequently held based on that portion of the work. If within 30 days of when payment becomes due the Owner does not release the retained funds due, interest shall accrue on the amount of retained funds at the rate of interest that is calculated as the prime rate plus one percent per year as of the day interest begins to accrue until the amount is paid.

9.10.7.3 If labor and/or materials are yet to be provided at the time the request for the release of the retained funds is made, an amount equal to 200% of the value of the labor and/or materials yet to be provided, as determined by the Owner, may be withheld until such labor and/or materials are provided.

9.10.7.4 An itemization of the labor and/or materials yet to be provided, or the reason that the request of retained funds is denied, shall be provided to the Contractor within 30 calendar days of the receipt for release of retained funds.

ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

10.2 SAFETY OF PERSONS AND PROPERTY

Delete Section 10.2.2 and substitute the following Section 10.2.2:

10.2.2 The Contractor shall give notices and comply with applicable laws, ordinances, regulations and lawful orders of public authorities bearing safety of persons or property or their protection from damage, injury or loss. This requirement also includes compliance with Iowa's Smoke Free Air Act and Iowa's Sex Offender law which no longer allows registered sex offenders to be on school property without the school's permission. Refer to the Acknowledgment and Certification document 00 7300.01 that all Contractors, Subcontractors, and Vendors must sign.

Delete Section 10.2.4 and substitute the following Section 10.2.4:

10.2.4 When use, handling, and/or storage of explosives or other hazardous materials or equipment or unusual methods is necessary for execution of the work, the Contractor shall give the Owner reasonable advance notice and shall exercise utmost care and carry on such activities under the supervision of properly qualified personnel.

10.3 HAZARDOUS MATERIALS

Add the following sentence to Section 10.3.4:

10.3.4 No product containing asbestos, Polychlorinated Biphenyl (PCB), lead-based materials or any other hazardous material identified by the United State Environmental Protection Agency shall be incorporated into the Work.

ARTICLE 11: INSURANCE AND BONDS

11.1 CONTRACTOR'S INSURANCE AND BONDS

Add the following paragraphs to Section 11.1.2

11.1.2.1 The Contractor shall deliver the required bonds to the Owner not later than seven days following the date the Agreement is entered into, or if the work is to be commenced prior thereto in response to a letter of intent, the Contractor shall, prior to commencement of the work, submit evidence satisfactory to the Owner that such bonds will be furnished.

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

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

Add the following Clause 12.2.2.4 to Section 12.2.2:

12.2.2.4 Upon request by the Owner and prior to the expiration of one year from the date of Substantial Completion, the Architect will conduct and the Contractor shall attend a meeting with the Owner to review the facility operations and performance.

ARTICLE 13: MISCELLANEOUS PROVISIONS

13.1 GOVERNING LAW

Delete the language in Section 13.1 and substitute the following language:

13.1 The Contract shall be governed by the law of the place where the Project is located.

13.4 TESTS AND INSPECTIONS

13.5 INTEREST

For Iowa governmental entities.

Delete Section 13.5 and substitute the following Section 13.5:

13.5 Payments due and unpaid under the Contract Documents shall bear interest from the date the payment is due and shall bear interest at the rate established by Section 74A.2 and 573.12, Code of Iowa, latest revision.

13.6 EQUAL EMPLOYMENT OPPORTUNITY

Add the following subparagraphs to 13.6:

13.6.1 The Contractor shall conform in all respects with the provisions of the Federal Civil Rights Act, the Code of Iowa, Chapter 216 Civil Rights Commission and the rules and regulations adopted thereto by the Iowa Civil Rights Commission. The Contractor shall not discriminate against any employee or applicant because of race, color, religion, sex, national origin, sexual orientation, gender identity, ancestry, age, marital status, physical or mental handicap. The Contractor shall require similar clauses in all of its subcontracts for service or materials.

13.6.1 The Contractor shall conform in all respects with the provisions of the Federal Civil Rights Act, the Illinois Human Rights Act and the rules and regulations adopted pursuant thereto by the Illinois Department of Human Rights. During the performance of the Contract, the Contractor shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, national origin, sexual orientation, gender identity, ancestry, age, marital status, physical or mental handicap or unfavorable discharge from military service. The Contractor shall also:

13.6.1.1 Refrain from unlawful discrimination and discrimination based on citizenship status in employment and undertake affirmative action to assure equality of employment opportunity and eliminate the effects of past discrimination.

13.6.1.2 Comply with procedures and requirements of the Department's regulations concerning equal employment opportunities and affirmative action;

13.6.1.3 Provide such information, with respect to its employees and applicants for employment, and assistance as the Department may reasonably request;

13.6.1.4 Have written sexual harassment policies that shall include, at a minimum, the following information: (i) the illegality of sexual harassment; (ii) the definition of sexual harassment under State law; (iii) a description of sexual harassment, utilizing examples; (iv) the vendor's internal complaint process including penalties; (v) the legal recourse, investigative and complaint process available through the Department and the Commission; (vi) directions on how to contact the Department and the Commission; and (vii) protection against retaliation as provided by Section 6-101 of this Act. A copy of the policies shall be provided to the Department upon request.

13.6.1.5 Require similar clauses in all of its subcontracts for services or materials.

ADD THE FOLLOWING SECTION TO ARTICLE 13:

13.7 NICOTINE FREE ZONE

Add the following subparagraph to 13.11:

13.7.1 Nicotine is not allowed on the Owner's premises which includes personal or company vehicles parked on the Owner's property.

ARTICLE 14: TERMINATION OR SUSPENSION OF THE CONTRACT

No Supplements

ARTICLE 15: CLAIMS AND DISPUTES

15.1 CLAIMS

Delete Section 15.1.2 in its entirety and substitute the following Section 15.1.2 and Clauses 15.1.2.1 thru 15.1.2.3:

15.1.2 Time Limits on Claims - As between the Owner and the Contractor, the commencement of the statutory limitation period shall be as follows:

15.1.2.1 Before Substantial Completion. As to acts or failures to act occurring prior to the relevant date of Substantial Completion, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than such date of Substantial Completion.

15.1.2.2 Between Substantial Completion and Final Certificate for Payment. As to acts or failures to act occurring subsequent to the relevant date of Substantial Completion and prior to issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of issuance of the final Certificate for Payment.

15.1.2.3 After Final Certificate of Payment. As to acts or failures to act occurring after the relevant date of issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of any act or failure to act by the Contractor pursuant to any Warranty provided under Section 3.5, the date of any correction of the Work or failure to correct the Work by the Contractor under Section 12.2, or the date of actual commission of any other act or failure to perform any duty or obligation by the Contractor or Owner, whichever occurs last.

Add Clauses 15.1.6.3 and 15.1.6.4 to Section 15.1.6:

15.1.6.3 Claims for increase in the Contract Time shall set forth in detail the circumstances that form the basis for the Claim, the date upon which each cause of delay began to affect the progress of the Work, the date upon which each cause of delay ceased to affect the progress of the Work and the number of days' increase in the Contract Time claimed as a consequence of each such cause of delay. The Contractor shall provide such supporting documentation as the Owner may require including, where appropriate, a revised construction schedule indicating all the activities affected by the circumstances forming the basis of the Claim.

15.1.6.4 The Contractor shall not be entitled to a separate increase in the Contract Time for each one of the number of causes of delay which may have concurrent or interrelated effects on the progress of the Work, or for concurrent delays due to the fault of the Contractor.

END OF SECTION

**SECTION 01 1000
SUMMARY**

PART 1 GENERAL

1.1 PROJECT

- A. Project Name: Shower House F.W. Kent Park
- B. Architect's Name: Shive-Hattery, Inc.
- C. The Project consists of the construction of a modular shower house, including foundations, utilities, mechanical systems, electrical systems, rooftop solar array, a prefabricated precast concrete shower house. The shower house will consist of eight (8) stalls and space for mechanical and electrical equipment. It will be heated and cooled using geothermal systems.

1.2 CONTRACT DESCRIPTION

- A. Contract Type: A single prime contract based on a Stipulated Price as described in Document 00 5200 - Agreement Form.

1.3 PROJECT SCHEDULE

- A. The project schedule is defined in the Advertisement for Bids.

1.4 OWNER OCCUPANCY

- A. Owner intends to occupy the Project upon Substantial Completion.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

1.5 CONTRACTOR USE OF SITE AND PREMISES

- A. General: Contractor shall have limited use of premises for construction operations as indicated on Drawings by the Contract limits.
- B. Construction Operations: Limited to areas noted on Drawings. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
- C. Provide access to and from site as required by law and by Owner:
 - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
 - 3. Driveways and Entrances: Keep driveways serving premises clear and available to Owner, Owner's employees, or emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
 - 4. Prevent accidental disruption of utility services to other facilities.

END OF SECTION

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**SECTION 01 2000
PRICE AND PAYMENT PROCEDURES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Procedures for preparation and submittal of applications for progress payments.
- B. Procedures for preparation and submittal of application for final payment.

1.2 RELATED REQUIREMENTS

- A. Section 00 5000 - Contracting Forms and Supplements: Forms to be used.
- B. Section 00 5200 - Agreement Form: Contract Sum, retainages, payment period, monetary values of unit prices.

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.
- B. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
 - 1. Application for Payment forms with Continuation Sheets.
 - 2. Submittals Schedule.
 - 3. Contractor's Construction Schedule.
- C. Form to be used: AIA Document G703 Continuation Sheets
- D. Content: Use the 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.
- E. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect/Engineer for approval.
- F. Forms filled out by hand will not be accepted.

- G. Submit Schedule of Values to Architect at earliest possible date but no later than 7 days after date on the Notice of Award OR Notice of Award.
- H. Format: Identify each line item with number and title of the specification Section. Identify site mobilization and bonds and insurance. Provide at least one line item for each Specification Section. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
 - 1. Related Specification Section or Division.
 - 2. Description of the Work.
 - 3. Name of subcontractor.
 - 4. Name of manufacturer or fabricator.
 - 5. Name of supplier.
 - 6. Change Orders (numbers) that affect value.
 - 7. Dollar value.
 - a. Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
- I. Revise schedule to list approved Change Orders, with each Application For Payment.
- J. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
- K. 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.
- L. Differentiate between items stored on-site and items stored off-site. If specified, include evidence of insurance or bonded warehousing.
- M. 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.
- N. 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 PROGRESS PAYMENTS

- A. Payment Period: Submit at intervals stipulated in the Agreement.
- B. Form to be used: AIA Document G702 and AIA Document G703 Continuation Sheets.
- C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect/Engineer for approval.
- D. Forms filled out by hand will not be accepted.
- E. For each item, provide a column for listing each of the following:
 - 1. Item Number.
 - 2. Description of work.
 - 3. Scheduled Values.
 - 4. Previous Applications.

Price and Payment

5. Work in Place and Stored Materials under this Application.
 6. Authorized Change Orders.
 7. Total Completed and Stored to Date of Application.
 8. Percentage of Completion.
 9. Balance to Finish.
 10. Retainage.
- F. Execute certification by signature of authorized officer.
- G. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
- H. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.
- I. Submit one electronic copy of each Application for Payment.
- J. Include the following with the application:
1. Partial release of liens or other claims from major subcontractors and vendors.
 - a. Conditional Waivers and Releases on progress payments: With each Application for Payment, submit waivers and releases from every entity who is lawfully entitled to file a mechanic's lien, claim payment against payment bond, or any other claim for payment arising out of the Contract and related to the Work covered by the current payment.
 - 1) Submit partial waiver and release on each item for amount requested in current application, after deduction for retainage, on each item.
 - 2) When an application shows completion of an item, submit final or full waivers and releases.
 - 3) Owner reserves the right to designate which entities involved in the Work must submit waivers.
 - b. 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 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 final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
- K. When Architect/Engineer requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date and line item by number and description.

- L. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 - 1. List of subcontractors.
 - 2. Schedule of Values.
 - 3. Contractor's Construction Schedule (preliminary if not final).
 - 4. Products list.
 - 5. List of Contractor's staff assignments.
 - 6. Copies of building permits.
 - 7. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 - 8. Initial progress report.
 - 9. Report of preconstruction conference.
 - 10. Certificates of insurance and insurance policies.
 - 11. Performance and payment bonds.
 - 12. Data needed to acquire Owner's insurance.
- M. Application for Payment at Substantial Completion: After receiving 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.
- N. Final Payment Application: 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.

1.6 APPLICATION FOR FINAL PAYMENT

- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- B. Application for Final Payment will not be considered until the following have been accomplished:
 - 1. All closeout procedures specified in Section 01 7000.

Price and Payment

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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**SECTION 01 2500
SUBSTITUTION PROCEDURES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Procedural requirements for proposed substitutions.

1.2 RELATED REQUIREMENTS

- A. Section 00 2113 - Instructions to Bidders: Restrictions on timing of substitution requests.
- B. Section 00 4325 - Substitution Request Form: Required form for substitution requests made prior to award of contract (During procurement).
- C. Section 00 6325 - Substitution Request Form - During Construction: Required form for substitution requests made after award of contract (During construction).
- D. Section 01 3000 - Administrative Requirements: Submittal procedures, coordination.
- E. Section 01 6000 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

1.3 DEFINITIONS

- A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
 - 1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
 - a. Unavailability.
 - b. Regulatory changes.
 - 2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
 - a. Substitution requests offering advantages solely to the Contractor will not be considered.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

- A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
 - 2. Agrees to provide the same warranty for the substitution as for the specified product.
 - 3. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.

4. Waives claims for additional costs or time extension that may subsequently become apparent.
5. Agrees to reimburse Owner and Architect/Engineer for review or redesign services associated with re-approval by authorities.
- B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
- C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
 1. Forms indicated in the Project Manual are adequate for this purpose and must be used.
- D. Limit each request to a single proposed substitution item.
 1. Submit an electronic document, combining the request form with supporting data into single document.

3.2 SUBSTITUTION PROCEDURES DURING PROCUREMENT

- A. Submittal Time Restrictions:
 1. Section 00 2113 - Instructions to Bidders specifies time restrictions and the documents required for submitting substitution requests during the bidding period.
- B. Submittal Form (before award of contract):
 1. Submit substitution requests by completing the form in Section 00 4325; see this section for additional information and instructions. Use only this form; other forms of submission are unacceptable.

3.3 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

- A. Submittal Form (after award of contract):
 1. Submit substitution requests by completing the form in Section 00 6325; see this section for additional information and instructions. Use only this form; other forms of submission are unacceptable.
- B. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect/Engineer, in order to stay on approved project schedule.
- C. Submit request for Substitution for Convenience within 14 days of discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect/Engineer, in order to stay on approved project schedule.
 1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
 2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
 3. Bear the costs engendered by proposed substitution of:
 - a. Owner's compensation to the Architect/Engineer for any required redesign, time spent processing and evaluating the request.
 - b. Other construction by Owner.
 - c. Other unanticipated project considerations.

- D. Substitutions will not be considered under one or more of the following circumstances:
1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
 2. Without a separate written request.
 3. When acceptance will require revisions to Contract Documents.

3.4 RESOLUTION

- A. Architect/Engineer may request additional information and documentation prior to rendering a decision. Architect will request information or documentation within 7 days of receipt of a request for substitution.
- B. Architect/Engineer will notify Contractor in writing of decision to accept or reject request within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

3.5 ACCEPTANCE

- A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.6 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. Include completed Substitution Request Forms as part of the Project record. Include both approved and rejected Requests.

END OF SECTION

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**SECTION 01 2600
CONTRACT MODIFICATION PROCEDURES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Minor Changes in the Work
- B. Proposal Requests
- C. Change Order Procedures
- D. Construction Change Directive

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, as a Software Generated "Architect's Supplemental Instruction".

1.4 PROPOSAL REQUESTS

- A. Proposal Requests: Construction Manager 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. Proposal Requests issued by Construction Manager are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
 - 2. Within 10 days 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.

- B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes 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 Division 01 Section 01 6000 "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.
 - 7. Proposal Request Form: Use Software-Generated Proposal Request.
- C. Stipulated Sum/Price Change Order: Based on Proposal Request and Contractor's fixed price quotation or Contractor's request for a Change Order as approved by Architect/Engineer.
- D. Unit Price Change Order: For predetermined unit prices and quantities, the Change Order will be executed on a fixed unit price basis. For unit costs or quantities of units of work which are not predetermined, execute Work under a Construction Change Directive. Changes in Contract Sum/Price or Contract Time will be computed as specified for Time and Material Change Order.
- E. Construction Change Directive: Architect/Engineer may issue a directive, on AIA Form G714 Construction Change Directive signed by the Owner, instructing the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work, and designate method of determining any change in Contract Sum/Price or Contract Time. Promptly execute the change.
- F. Time and Material Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract. Architect/Engineer will determine the change allowable in Contract Sum/Price and Contract Time as provided in the Contract Documents.
- G. Maintain detailed records of work done on Time and Material basis. Provide full information required for evaluation of proposed changes, and to substantiate costs for changes in the Work.
- H. Change Order Forms: AIA G701 Change Order.
- I. Execution of Change Orders: Architect/Engineer will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

1.5 CHANGE ORDER PROCEDURES

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

Contract Modification

Procedures

01 2600 - 2

**Issued for Bid
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1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Construction Manager may issue a Construction Change Directive on EJCDC Document C-940. 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 Work Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 2600

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**SECTION 01 3000
ADMINISTRATIVE REQUIREMENTS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General administrative requirements.
- B. Administrative and supervisory personnel
- C. Requests for information (RFI).
- D. Electronic document submittal service.
- E. Preconstruction meeting.
- F. Pre-installation meeting.
- G. Progress meetings.
- H. Construction progress schedule.
- I. Submittals for review, information, and project closeout.
- J. Number of copies of submittals.
- K. Submittal procedures.

1.2 RELATED REQUIREMENTS

- A. Section 01 6000 - Product Requirements: General product requirements.
- B. Section 01 7000 - Execution and Closeout Requirements: Additional coordination requirements.
- C. Section 01 7800 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.
- D. Section 01 9113 - General Commissioning Requirements: Additional procedures for submittals relating to commissioning.
 - 1. Where submittals are indicated for review by both Architect/Engineer and the Commissioning Provider (CxP), submit one extra and route to Architect/Engineer first for forwarding to the Commissioning Provider.
 - 2. Where submittals are not indicated to be reviewed by Architect/Engineer, submit directly to the Commissioning Provider (CxP); otherwise, the procedures specified in this section apply to commissioning submittals.

1.3 REFERENCE STANDARDS

- A. AIA G810 - Transmittal Letter; 2001.

1.4 GENERAL ADMINISTRATIVE REQUIREMENTS

- A. Comply with requirements of Section 01 7000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.

B. Make the following types of submittals to Architect/Engineer:

1. Requests for Information (RFI).
2. Requests for substitution.
3. Shop drawings, product data, and samples.
4. Test and inspection reports.
5. Design data.
6. Manufacturer's instructions and field reports.
7. Applications for payment and change order requests.
8. Progress schedules.
9. Coordination drawings.
10. Correction Punch List and Final Correction Punch List for Substantial Completion.
11. Closeout submittals.

1.5 DEFINITIONS

- A. RFI: Request from Contractor seeking interpretation, information, or clarification of the Contract Documents.
- B. Action Submittals: Written and graphic information that does require Architect's responsive action.
- C. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements.
- D. Field and File: Written information that does not require Architect's responsive action. Information required to be accessed on site, for example; Safety Data Sheets.

1.6 PROJECT COORDINATION

- A. Each contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.
- B. 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.
- C. 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.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to the conservation of energy, water, and materials.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

1.7 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

- A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including the superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, email addresses, and telephone numbers, including home, mobile, and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to the Project.

1.8 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
- B. 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.
- C. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
- D. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
 - 1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Information (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
 - 2. Contractor and Architect/Engineer are required to use this service.

3. It is Contractor's responsibility to submit documents in allowable format.
 4. Subcontractors, suppliers, and Architect/Engineer's consultants are to be permitted to use the service at no extra charge.
 5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
 6. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
 7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
- B. Submittal Service: The selected service is:
1. Newforma Info Exchange: <https://www.shive-hattery.com/new-forma>
 2. Procore www.procore.com If Procore is used by the Contractor the Architect will connect Newforma using a Connector API.
- C. Training: A minimum one, one-hour, web-based training session will be arranged for all participants, with representatives of Architect/Engineer and Contractor participating; further training is the responsibility of the user of the service.
- D. Project Closeout: Architect/Engineer will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

3.2 NEWFORMA INFO EXCHANGE SERVER

- A. Newforma Info Exchange server: The Architect will provide the Contractor access to this server to download and upload files via any internet-capable computer running an internet browser such as Microsoft Edge, Google Chrome, etc.
- B. Benefits and features of Newforma Info Exchange for the Contractor include:
1. A collaborative submittal log is maintained within Newforma Info Exchange by the Architect and Contractor.
 2. Submittal data files transmitted through Newforma Info Exchange bypass the file size limits of email systems.
 3. Submittal data files transferred through Newforma Info Exchange are encrypted.
 4. Notifications and reminders can be optionally scheduled and expiration dates for documents can be automatically set.
- C. Exceptions: The following submittals are not to be done electronically.
1. Samples, color charts, original warranties, and notarized affidavits.

3.3 PRECONSTRUCTION MEETING

- A. Schedule meeting after Notice of Award.
- B. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
- C. Attendance Required Authorized Representatives of:
1. Owner.
 2. Architect/Engineer and their subconsultants.

3. Contractor and its superintendent; major subcontractors; suppliers, and other concerned parties.
- D. Agenda: Discuss items of significance that could affect progress, including the following:
1. Execution of Owner-Contractor Agreement.
 2. Submission of executed bonds and insurance certificates.
 3. Distribution of Contract Documents.
 4. Procedure for maintaining Record Documents.
 5. Use of premises and existing building.
 6. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
 7. Submission of initial Submittal schedule.
 8. Designation of personnel representing the parties to Contract and their duties.
 9. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 10. Scheduling (tentative construction schedule and phasing).
 11. Critical work sequencing and long-lead items.
 12. Procedures for testing and inspecting.
 13. Work restrictions.
 14. Owner's occupancy requirements.
 15. Responsibility for temporary facilities and controls.
 16. Construction waste management and recycling.
 17. Parking availability.
 18. Office, work, and storage areas.
 19. Equipment deliveries and priorities.
 20. Warranties and Warranty requirements.
 21. First aid.
 22. Safety and Security.
 23. Progress cleaning.
 24. Working hours.
- E. Architect will record minutes and distribute copies within two days after meeting to participants, with two copies to Architect/Engineer, Owner, Contractor participants, and those affected by decisions made.

3.4 PREINSTALLATION MEETINGS

- A. Schedule meeting at the Project site prior to Contractor occupancy.
- B. Attendance Required:: 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 of scheduled meeting dates.
1. Contractor.
 2. Owner.

3. Architect/Engineer.
 4. Contractor's superintendent.
 5. Major subcontractors.
- C. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
1. The Contract Documents.
 2. Use of premises by Owner and Contractor.
 3. Construction facilities and controls provided by Owner.
 4. Temporary utilities provided by Owner.
 5. Temporary facilities and controls.
 6. Security and housekeeping procedures.
 7. Schedules, including time schedules.
 8. Application for payment procedures.
 9. Procedures for maintaining record documents.
 10. Incomplete, illegitimate, or frivolous Contractor's requests for information and requests for information that are not prepared in accordance with the Contract Documents.
 11. Contractor requests for information where the requested information is available to the Contractor from a careful study and comparison of the contract documents, field conditions, contractor-prepared coordination drawings, other owner/architect-provided information or prior project correspondence or documentation.
 12. Related RFIs.
 13. Deliveries.
 14. Review of mockups.
 15. Compatibility problems.
 16. Weather limitations.
 17. Manufacturer's written recommendations.
 18. Warranty requirements.
 19. Space and access limitations.
 20. Installation procedures.
 21. Protection of adjacent work.
 22. Protection of construction and personnel.
- D. 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.
- E. Record minutes and distribute copies within two days after meeting to participants, with electronic copies to Architect/Engineer, Owner, participants, and those affected by decisions made. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

3.5 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the Work at maximum bi-weekly intervals. Coordinate dates of meetings with preparation of payment requests.
- B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required: Owner, Architect/Engineer, Contractor Project Manager and Job Superintendent as appropriate to agenda topics for each meeting. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
- D. Agenda:
 - 1. Review minutes of previous meetings.
 - 2. Review of work progress.
 - 3. Field observations, problems, and decisions.
 - 4. Identification of problems that impede, or will impede, planned progress.
 - 5. Review of submittals schedule and status of submittals.
 - 6. Review of RFIs log and status of responses.
 - 7. Review of off-site fabrication and delivery schedules.
 - 8. Maintenance of progress schedule.
 - 9. Corrective measures to regain projected schedules.
 - 10. Planned progress during succeeding work period.
 - 11. Coordination of projected progress.
 - 12. Maintenance of quality and work standards.
 - 13. Effect of proposed changes on progress schedule and coordination.
 - 14. Access.
 - 15. Site utilization.
 - 16. Temporary facilities and controls.
 - 17. Work hours.
 - 18. Hazards and risks.
 - 19. Progress cleaning.
 - 20. Status of correction of deficient items.
 - 21. Field observations.
 - 22. RFIs.
 - 23. Status of proposal requests.
 - 24. Status of Change Orders.
 - 25. Pending claims and disputes.
 - 26. Documentation of information for payment requests.
 - 27. Other business relating to work.
- E. Record minutes and distribute copies within two days after meeting to participants, and those affected by decisions made.

3.6 PROJECT CLOSEOUT CONFERENCE

- A. Schedule the conference to review requirements and responsibilities related to project closeout. Set a time convenient to Owner and Architect, but no later than 30 days prior to the scheduled date of substantial completion.
 - 1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and their superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with the Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Procedures required prior to Substantial Completion Inspection and Final Completion Inspection.
 - 1) Procedure to request Architect review to determine the date of Substantial Completion.
 - 2) Preparation and submission of Contractor's punch list.
 - 3) Architect's process for Substantial Completion review and preparation of the supplemental and final punch lists.
 - b. Procedures for processing Applications for Payment at Substantial Completion and Final Completion.
 - c. Requirements for completing Closeout Documentation.
 - 1) Affidavits
 - 2) Release of Claims or Liens
 - d. Completion time for correcting defective work.
 - e. Partial release of Retainage
 - f. Preparation and submission of Record Documents
 - g. Responsibility for removing temporary facilities and controls.
 - h. Final cleaning
 - i. Preparation for final completion review.
 - 3. Record minutes and distribute copies within two days after meeting to participants, and those affected by decisions made.

3.7 CONSTRUCTION PROGRESS SCHEDULE

- A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
 - 1. Include written certification that major contractors have reviewed and accepted proposed schedule.
- D. Within 10 days after joint review, submit complete schedule.

- E. Submit updated schedule with each Application for Payment.

3.8 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
1. Product data.
 2. Shop drawings.
 3. Samples for selection.
 4. Samples for verification.
- B. Submit to Architect/Engineer for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
- C. Samples will be reviewed for aesthetic, color, or finish selection.
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 7800 - Closeout Submittals.

3.9 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
1. Design data.
 2. Certificates.
 3. Test reports.
 4. Inspection reports.
 5. Manufacturer's instructions.
 6. Manufacturer's field reports.
 7. Other types indicated.
- B. Submit for Architect/Engineer's knowledge as contract administrator or for Owner.

3.10 SUBMITTALS FOR PROJECT CLOSEOUT

- A. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 7800 - Closeout Submittals:
1. Project record documents.
 2. Operation and maintenance data.
 3. Warranties.
 4. Bonds.
 5. Other types as indicated.

3.11 NUMBER OF COPIES OF SUBMITTALS

- A. Electronic Documents: Submit one electronic copy in Adobe Portable Document Format PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected. Submit separate PDF files for each specification section. Multiple sections combined into one PDF file will be returned to the Contractor.
1. Name Files according to the following format: <Section Number> <Item Description>. For example: 08 1113 Hollow Metal Doors Shop Drawings.

2. For shop drawings, the size of the electronic image must be equal with the standard paper size of the sheet, for example:
 3. A 30" x 42" drawing should not be placed on an 11" x 17" sheet size.
 4. An 11" x 17" drawing should not be placed on a 30" x 42" sheet size.
 5. For electronic shop drawings larger than 11" x 17", one hard copy of the drawing(s) is required to be submitted with the electronic copy. The hard copy will NOT be returned to the Contractor.
 6. If the Architect deems the electronic submittal illegible, corrupted, and unusable, or if the file size is unreasonably large, then a new electronic copy or hard copy will be required.
- B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect/Engineer.
1. After review, produce duplicates of the Architect's review information.
 2. Retained samples will not be returned to Contractor unless specifically so stated.

3.12 SUBMITTAL PROCEDURES

- A. General Requirements:
1. Use a separate transmittal for each item.
 2. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
 3. Transmit using approved form.
 4. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
 5. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
 6. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
 - a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
 7. Schedule submittals to expedite the Project, and coordinate submission of related items.
 - a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
 - b. For sequential reviews involving Architect/Engineer's consultants, Owner, or another affected party, allow an additional 7 days.
 8. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
 9. Provide space for Contractor and Architect/Engineer review stamps.
 10. When revised for resubmission, identify all changes made since previous submission.
 11. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
 12. Submittals not requested will be recognized, and will be returned "Not Reviewed",

B. Product Data Procedures:

1. Submit only information required by individual specification sections.
2. Collect required information into a single submittal.
3. Submit concurrently with related shop drawing submittal.
4. Do not submit (Material) Safety Data Sheets for materials or products.

C. Samples Procedures:

1. Transmit related items together as single package.
2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
3. Include with transmittal high-resolution image files of samples to facilitate electronic review and approval. Provide separate submittal page for each item image.

D. Shop Drawing Procedures:

1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting the Contract Documents and coordinating related Work.
2. Generic, non-project specific information submitted as shop drawings do not meet the requirements for shop drawings.

E. Submittal System: The contractor will provide electronic submittals using Newforma Info Exchange Server or an Electronic Document Submittal Service.

F. Submittal Schedule:

1. The Contractor will prepare a submittal schedule.
 - a. The Architect will provide a submittal template to the Contractor for use in preparing the submittal schedule for use with Newforma Info Exchange. The Architect will import the schedule after the initial submittal and the final submittal.
2. In preparing the schedule, the Contractor should consider time required for review, ordering, manufacturing, fabrication, and delivery plus include additional time required for making corrections or revision to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
 - a. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 - b. 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.
 - c. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
 - d. Format: Arrange the following information in a tabular format:
 - 1) Schedule date for first submittal.
 - 2) Specification Section number and title.
 - 3) Submittal category: Action or Informational.
 - 4) Name of subcontractor.

- 5) Description of the Work covered.
 - 6) Scheduled date for Architect's final release or approval.
 - 7) Scheduled date of fabrication.
 - 8) Scheduled dates for purchasing.
 - 9) Scheduled dates for installation.
 - 10) Activity or event number.
- G. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
1. 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. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received. This includes the right to withhold action on a submittal requiring color selection until all related color samples or submittals are received.
 2. The Contractor is responsible for assuring that each submittal is in full compliance with the submittal requirements prior to forwarding to the Architect for review. Submittals which are incomplete will be considered as not submitted until all submittal requirements are fulfilled. The architect has sole discretion to return incomplete submittals without review, to hold submittals until all requirements are fulfilled, to review partial submittals, or to waive partial requirements. In exercising this discretion, the Architect will incur no obligation to apply the same action to any other submittal.
 3. The Contractor is responsible for timely submission of submittals to allow for review and any subsequent corrections necessary prior to undertaking any work covered by the submittal.
- H. Processing Time: Allow enough time for submittal review, including time for re-submittals, 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 re-submittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals or consultants is required. Architect will advise Contractor when a submittal being processed requires extended review time 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 the Contract Documents indicate that submittals shall be reviewed sequentially by Architect's consultants, Owner, or other parties, 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.

6. Except for required concurrent reviews, the Contractor shall not retain or suppress submittals for group submissions. Each individual submittal is to be transmitted expeditiously upon preparation. Numerous submittals transmitted in a short time period will not be considered reasonable and will result in review times being extended accordingly. In such cases, the Contractor may request priority consideration of certain submittals.
7. Should the Contractor request an expedited review in order to maintain schedule, the requests will be approved at the sole discretion of Architect. Rejection will not be cause for any claims for delay or additional cost by the Contractor. The Contractor shall be solely responsible should such rejection result in the completion of construction to occur after the contract deadlines.
- I. Transmittal Form: Use Newforma Info Exchange Transmittal as approved by the Architect. When using the Architect's electronic submittal procedure, the transmittal form is part of the submittal file.
- J. Transmit each submittal with a copy of approved submittal form.
- K. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will reject and return received from sources other than Contractor.
 1. Transmittal Form Content: Provide locations on form for the following information:
 - a. Project name.
 - b. Date.
 - c. Destination (To:).
 - d. Source (From:).
 - e. Names of subcontractor, manufacturer, and supplier.
 - f. Category and type of submittal.
 - g. Submittal purpose and description.
 - h. Specification Section number and title.
 - i. Transmittal number (numbered consecutively).
 - j. Remarks.
 - k. Signature of transmitter.
- L. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.
- M. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.
- N. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.

- O. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
- P. Include the following information on label for processing and recording action taken:
 - 1. Project name.
 - 2. Date.
 - 3. Name and address of Architect.
 - 4. Name and address of Contractor.
 - 5. Name and address of subcontractor.
 - 6. Name and address of supplier.
 - 7. Submittal number or other unique identifier, including revision identifier.
 - a. Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06-1000.01). Re-submittals shall include an alphabetic suffix after another decimal point (e.g., 06-1000.01.A).
- Q. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.
- R. When revised for resubmission, identify all changes made since previous submission.
- S. Distribute reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.
- T. Submittals not requested will not be recognized or processed.

3.13 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. Product Data includes printed information, such as manufacturer's installation instructions, catalog cuts, standard color charts, rough-in diagrams and templates, standard wiring diagrams, and performance curves. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each submittal to show which products and options are applicable. Where printed Product Data includes information on several products that are not required, mark copies to indicate the applicable information.
 - 3. Submit Product Data before or concurrent with Samples.
- C. 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. Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.
 - 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. Number and title of appropriate Specification Section.
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.

3.14 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
 1. Number of Copies: Submit PDF copies of each submittal, unless otherwise indicated. Architect will not return copies.
 2. O&M and Closeout Requirements: Retain submission of closeout documentation (Manufacturer's Instructions, Warranties, etc.) until the end of the project, do not submit with individual specification section Product Data or Shop Drawing Submittals. Comply with the requirements specified in Division 01 Execution and Closeout Requirements.
- B. Contractor's Construction Schedule: Comply with requirements specified in Division 01 "Construction Progress Schedule."
- C. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 "Closeout Submittals."
- D. Design Data: Prepare 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.
- E. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.
- F. Material Safety Data Sheets (SDS): Submit information directly to Owner; do not submit to Architect except as required in "Action Submittals" Article.

3.15 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.

- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and three copies of a statement, 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.

3.16 CONTRACTOR'S REVIEW

- A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Review each submittal for accuracy and completeness of dimensions and quantities, and for performance of equipment or systems. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect. Submittals deemed by the Architect to not have been reviewed by the Contractor prior to submission may be returned and considered as "Not Submitted".
- B. 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 and coordinated with other Work of the contract.

3.17 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
 - 1. Furnish as Submitted: Denotes that the submittal meets the criteria of the drawings and specifications and no revisions are required. The Contractor may proceed with fabrication or procurement of the item reviewed and may proceed with the work shown on the drawings and specifications for this item.
 - 2. Furnish as Corrected: Denotes that there are deficiencies, but the Contractor may proceed with fabrication or procurement of the item reviewed and may proceed with the work shown on the drawings and specifications for the item if the deficiencies are first corrected.
 - 3. Revise and Resubmit: Denotes that the submittal does apply to the drawings and specifications, but insufficient detail has been shown or the submittal contains too many errors or omissions. The Contractor may NOT proceed with fabrication or procurement of the item reviewed and may NOT proceed with the work shown on the drawings and specifications for the item. The Contractor must revise the submittal and resubmit for review.
 - 4. Incomplete - Resubmit: Denotes that some portion of the submittal is incomplete and the Architect cannot, therefore, review the submittal. The Architect will describe the incompleteness by comment on the submittal. The Contractor may NOT proceed with fabrication or procurement of the item reviewed and may NOT proceed with the work shown on the drawings and specifications for the item. The Contractor must revise the submittal and resubmit for review.

- 5. Rejected: Denotes that the submittal does not apply to the item specified or was not specified. The Contractor may NOT proceed with fabrication or procurement of the item reviewed and may NOT proceed with the work shown on the drawings and specifications for the item, and the Contractor must prepare a new submittal. The Architect will describe the reason for rejection by comment on the submittal.
- C. Informational Submittals: Architect will review each submittal and will not return it or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.
- F. Architects review is only for limited purpose of checking for general conformance with the information given and design concept expressed in the Contract Documents.
- G. Unless notified otherwise by the Contractor, the Architect's notations, comments, and mark-ups on approved submittals shall have the same effect as the Architect's order for minor changes in the Work not involving adjustment in the contract sum or extension in the contract time. The Contractor will proceed with the work, and the response will be incorporated into the contract the same as the Architect's written order for minor changes in the Work. Notify Architect in writing if noted modifications cannot be made due to conflicting circumstances in the field, in other contract documents, or for other reasons.
- H. If the Contractor believes that the Architect's notations, comments, or mark-ups constitute a change that results in added cost or time, the Contractor is to notify the Architect in writing within seven (7) days of receipt of the reviewed submittal. Do not proceed with changes that result in added cost or time until the matter is resolved in accordance with other provisions of the contract.

END OF SECTION

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**SECTION 01 4000
QUALITY REQUIREMENTS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Testing and inspection agencies and services.
- B. Contractor's design-related professional design services.
- C. Control of installation.
- D. Defect Assessment.

1.2 RELATED REQUIREMENTS

- A. Section 01 4216 - Definitions.

1.3 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Base design on performance and/or design criteria indicated in individual specification sections.
 - 1. Submit a Request for Information to Architect/Engineer if the criteria indicated are not sufficient to perform required design services.
- C. Scope of Contractor's Professional Design Services: Provide for the following items of work:
 - 1. Structural Calculations and Design: As described in Section 13 4345 - Modular Precast Concrete Structures.

1.4 TESTING AND INSPECTION AGENCIES AND SERVICES

- A. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
- B. 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 and the Contract Sum will be adjusted by Change Order.

PART 2 PRODUCTS

2.1 REQUIREMENTS

- A. Comply with the requirements specified in Division 01 Product Requirements.

PART 3 EXECUTION

2.2 TEST AND INSPECTION LOG

- A. 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 modifications as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

2.3 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. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
 - 2. Comply with the Contract Document requirements for Division 01 Section "Cutting and Patching."
- 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.

2.4 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

2.5 TESTING AND INSPECTION

- A. Testing Agency Duties:
 - 1. Provide qualified personnel at site. Cooperate with Architect/Engineer and Contractor in performance of services.

2. Perform specified sampling and testing of products in accordance with specified standards.
 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 4. Promptly notify Architect/Engineer and Contractor of observed irregularities or non-compliance of Work or products.
 5. Perform additional tests and inspections required by Architect/Engineer.
 6. Submit reports of all tests/inspections specified.
- B. Limits on Testing/Inspection Agency Authority:
1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 2. Agency may not approve or accept any portion of the Work.
 3. Agency may not assume any duties of Contractor.
 4. Agency has no authority to stop the Work.
- C. Contractor Responsibilities:
1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
 2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
 3. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
 - c. To facilitate tests/inspections.
 - d. To provide storage and curing of test samples.
 4. Notify Architect/Engineer and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- D. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect/Engineer.
- E. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor. 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, and the Contract Sum will be adjusted by Change Order.
- F. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for commencement of the Work.
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.

2.6 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not complying with specified requirements.

END OF SECTION

SECTION 01 4216
DEFINITIONS

PART 1 GENERAL

1.1 SUMMARY

- A. This section supplements the definitions contained in the Drawings general provisions of the Contract, including General and Supplementary Conditions.
- B. Other definitions are included in individual specification sections.

1.2 DEFINITIONS

- A. "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.
- B. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."
- C. "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."
- D. "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.
- E. "Furnish" or "Supply": To supply, deliver to Project site, unload, and inspect for damage.
- F. "Install": Operations at Project site including to temporarily store, unpack, assemble, erect, apply, place, anchor, work to dimension, finish, cure, protect, clean, start up, and make ready for use.
- G. "Provide": Furnish and install, complete and ready for the intended use.
- H. "Product": Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.
- I. "Project Manual": The book-sized volume that includes the procurement requirements (if any), the contracting requirements, and the specifications.
- J. "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.
- D. Abbreviations and Acronyms for Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the generally recognized name of the standards and regulations or as indicated.

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 Research's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S." unless otherwise indicated.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 01 5000
TEMPORARY FACILITIES AND CONTROLS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Temporary utilities.
- B. Temporary sanitary facilities.
- C. Temporary Controls: Barriers.
- D. Security requirements.
- E. Waste removal facilities and services.

1.2 TEMPORARY UTILITIES

- A. Owner will provide the following:
 - 1. Electrical power and metering, consisting of connection to existing facilities.
 - 2. Water supply, consisting of connection to existing facilities.
- B. Use trigger-operated nozzles for water hoses, to avoid waste of water.

1.3 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. Maintain daily in clean and sanitary condition.

1.4 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- C. Provide protection for plants designated to remain. Replace damaged plants.
- D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.5 SECURITY

- A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

1.6 VEHICULAR ACCESS AND PARKING

- A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
- B. Coordinate access and haul routes with governing authorities and Owner.
- C. Provide and maintain access to fire hydrants, free of obstructions.

- D. Provide means of removing mud from vehicle wheels before entering streets.
- E. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

1.7 WASTE REMOVAL

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B. Provide containers with lids. Remove trash from site periodically.
- C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 01 6000
PRODUCT REQUIREMENTS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Administrative and procedural requirements for selection of products for use in Project
- B. Product delivery
- C. Manufacturers' standard special warranties on products
- D. Comparable products
- E. Transportation, handling, storage and protection.
- F. Product option requirements.
- G. Substitution limitations.
- H. Maintenance materials, including extra materials, spare parts, tools, and software.

1.2 RELATED REQUIREMENTS

- A. Section 01 2500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.

1.3 DEFINITIONS

- A. Products: Items purchased 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 consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, 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. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," 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 other named manufacturers.

1.4 SUBMITTALS

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.
- D. Comparable Product Requests: Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Conditions: Architect will consider Contractor's request for comparable product 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. Evidence that the proposed product does not require extensive 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.
 - b. 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.
 - c. Evidence that proposed product provides specified warranty.
 - d. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 - e. Samples, if requested.
 - 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 of approval or rejection of proposed comparable product request within 15 days of receipt of request, or __ days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: Comply with requirements specified in Division 01 "Administrative Requirements."

1.5 COMPATIBILITY OF OPTIONS

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
 - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.

2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 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: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - a. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
 - b. Refer to Divisions 02 through 48 for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 01 "Execution and Closeout Requirements" and "Closeout Submittals."

PART 2 PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that 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.
 - a. 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.
 - 1) Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 - 2) Where products are accompanied by the term "as selected," Architect will make selection.
 - 3) Where products are accompanied by the term "match sample," sample to be matched is Architect's.
 - 4) Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

- 5) Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Comparable Product Requests" Article to obtain approval for use of an unnamed product

B. Product Selection Procedures.

1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Product Requests" Article for consideration of an unnamed product.
6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Product Requests" Article for consideration of an unnamed product.
7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified 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 provisions in Part 2 "Comparable Product Requests" Article for consideration of an unnamed product by the other named manufacturers.
9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 - a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.
10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.

2.2 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by Contract Documents.
- B. Use of products having any of the following characteristics is not permitted:
 1. Containing lead, cadmium, or asbestos.

2.3 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

PART 3 EXECUTION

3.1 SUBSTITUTION LIMITATIONS

- A. See Section 01 2500 - Substitution Procedures.

3.2 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft.
- D. 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.
- E. 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.
- F. Coordinate schedule of product delivery to designated prepared areas at project site in order to minimize long-term site storage time, overcrowding of construction spaces, and potential damage to stored materials.
- G. Transport and handle products in accordance with manufacturer's instructions.
- H. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- I. Promptly inspect shipments on delivery to ensure that products comply with requirements of the Contract Documents, quantities are correct, and products are properly protected and undamaged.
- J. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- K. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.3 STORAGE AND PROTECTION

- A. Store and protect products in accordance with manufacturers' instructions.
- B. Store with seals and labels intact and legible.
- C. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

- D. For exterior storage of fabricated products, place on sloped supports above ground.
- E. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- F. Comply with manufacturer's warranty conditions, if any.
- G. Cover products subject to deterioration by the elements, above ground, with impervious sheet covering. Provide adequate ventilation to prevent condensation and degradation of products.
- H. Prevent contact with material that may cause corrosion, discoloration, or staining.
- I. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- J. Arrange storage of products to permit access for inspection and measurement of quantity or counting of units. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.
- K. Store materials in a manner that will not endanger Project structure.
- L. Store cementitious products and materials on elevated platforms.
- M. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage
- N. Protect stored products and liquids from damage from freezing

END OF SECTION

**SECTION 01 7000
EXECUTION AND CLOSEOUT REQUIREMENTS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Pre-installation meetings.
- C. Cutting and patching.
- D. Surveying for laying out the work.
- E. Cleaning and protection.
- F. Demonstration and instruction of Owner personnel.
- G. Substantial Completion.
- H. Final Completion.
- I. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
- J. General requirements for maintenance service.

1.2 RELATED REQUIREMENTS

- A. Section 01 3000 - Administrative Requirements: Submittals procedures, Electronic document submittal service.
- B. Section 01 4000 - Quality Requirements: Testing and inspection procedures.
- C. Section 01 7800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties, and bonds.
- D. Section 01 9113 - General Commissioning Requirements: Contractor's responsibilities in regard to commissioning.

1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Permits: Submit copies of all permits obtained from authorities having jurisdiction over the work of the project.

1.4 QUALIFICATIONS

- A. For surveying work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect/Engineer. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

1.5 PROJECT CONDITIONS

- A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

- B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- C. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
 - 1. Minimize amount of bare soil exposed at one time.
 - 2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
 - 3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
 - 4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- D. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.6 COORDINATION

- A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Notify affected utility companies and comply with their requirements.
- C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean-up of work of separate sections.
- G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.7 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
 - 1. Prepare and submit a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete. Additionally, attach a copy of work required for each room to the door entering the room. Subcontractor and Superintendent to initial as each Work item is completed. Attach supplemental lists as required.
 - 2. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.

3. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases by applicable authorities having jurisdiction.
 4. Prepare and submit updated Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
 5. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable. Obtain signed receipt of delivery from the Owner listing materials and quantities and submit to the Architect.
 6. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance (including Operation & Maintenance Manuals).
 8. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection Procedures: Submit a written request for inspection for Substantial Completion a minimum of seven (7) days in advance of the requested Substantial Completion inspection date. On receipt of request, Architect may notify Contractor of unfulfilled requirements. On date of inspection, Architect will conduct a review and either proceed with inspection or notify Contractor that the project is not Substantially Complete due to unfulfilled requirements.
1. Upon inspection the Architect and the Owner's representative will accompany the Contractor on a walk-through review of the Contractor's punch list. Should the Architect and/or the Owner's representative observe work which is incomplete or defective which is not included on the contractor's punch list, the Architect will prepare a supplemental punch list of items to be completed or corrected.
 2. 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.
 3. Results of the completed inspection will form the basis of requirements for establishing Final Completion.

1.8 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
1. Submit a final Application for Payment according to Division 01 Section "Price and Payment Procedures".
 2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Contractor. The certified copy of the list shall state that the Work, including each item on the list has been completed or otherwise resolved for acceptance. Provide explanations for each proposed resolution to incomplete items.
 3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report and warranty.

5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training videos. Obtain signed attendance sheets and submit them to the Architect.
- B. Inspection Procedures: Submit a written request for inspection for Final Completion, a minimum of (7) days in advance of the requested Final Completion Inspection Date. On receipt of request, Architect may notify Contractor of unfulfilled requirements. On date of inspection, Architect will conduct a review and either proceed with inspection or notify Contractor that the project is not Finally Complete due to unfulfilled requirements.
 1. Upon Inspection the Architect and the Owner's representative will accompany the Contractor's superintendent on a walk-through review of the Substantial Completion punch list.
 2. Architect will process the final Application for Payment after inspection providing all closeout documentation has been received and is acceptable, or the Architect will notify Contractor of construction and/or documentation that must be completed or corrected before final Application for Payment will be processed.

1.9 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit one electronic copy 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. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.

1.10 WARRANTIES

- A. Submittal Time: 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.
- 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 the Project Manual.
 1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) 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.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.1 PATCHING MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- C. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.
- D. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.

2.2 CLEANING PRODUCTS

- 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.

PART 3 EXECUTION

3.1 PREINSTALLATION MEETINGS

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect/Engineer four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 1. Review conditions of examination, preparation and installation procedures.
 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect/Engineer, Owner, participants, and those affected by decisions made.

3.2 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect/Engineer of any discrepancies discovered.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

- D. Promptly report to Architect/Engineer the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect/Engineer.
- F. Utilize recognized engineering survey practices.
- G. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.
- H. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
 - 2. Grid or axis for structures.
 - 3. Building foundation, column locations, ground floor elevations.
- I. Periodically verify layouts by same means.
- J. Maintain a complete and accurate log of control and survey work as it progresses.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

3.4 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or 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. Perform whatever cutting and patching is necessary to:
 - 1. Complete the work.
 - 2. Fit products together to integrate with other work.
 - 3. Provide openings for penetration of mechanical, electrical, and other services.
 - 4. Match work that has been cut to adjacent work.
 - 5. Repair areas adjacent to cuts to required condition.
 - 6. Repair new work damaged by subsequent work.
 - 7. Remove samples of installed work for testing when requested.
 - 8. Remove and replace defective and non-complying work.

- C. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Proceed with patching after construction operations requiring cutting are complete.
- D. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- E. Cut rigid materials such as concrete and masonry using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- F. Restore work with new products in accordance with requirements of Contract Documents.
- G. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- 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 possible. Provide materials and comply with installation requirements specified in other Sections.
 - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
 - 2. Match color, texture, and appearance.
 - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.
 - 4. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 - 5. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 - 6. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 - 7. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

3.5 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

- B. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.6 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.7 DEMONSTRATION AND INSTRUCTION

- A. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.
- B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- C. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.

3.8 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.
- B. Testing, adjusting, and balancing HVAC systems: See Section 23 0593 - Testing, Adjusting, and Balancing for HVAC.

3.9 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

3.10 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
- B. Notify Architect/Engineer when work is considered ready for Architect/Engineer's Substantial Completion inspection.
- C. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect/Engineer's Substantial Completion inspection.
- D. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect/Engineer's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect/Engineer.
- E. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- F. Notify Architect/Engineer when work is considered finally complete and ready for Architect/Engineer's Substantial Completion final inspection.

- G. Complete items of work determined by Architect/Engineer listed in executed Certificate of Substantial Completion.

3.11 MAINTENANCE

- A. Provide service and maintenance of components indicated in specification sections.
- B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.
- C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
- E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION

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**SECTION 01 7419
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**

PART 1 GENERAL

1.1 WASTE MANAGEMENT REQUIREMENTS

- A. Owner requires that this project generate the least amount of trash and waste possible.
- B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- D. Contractor Reporting Responsibilities: Submit periodic Waste Disposal Reports; report landfill disposal, incineration, recycling, salvage, and reuse regardless of to whom the cost or savings accrues; use the same units of measure on required reports.
- E. Methods of trash/waste disposal that are not acceptable are:
 - 1. Burning on the project site.
 - 2. Burying on the project site.
 - 3. Dumping or burying on other property, public or private.
 - 4. Other illegal dumping or burying.
- F. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.2 DEFINITIONS

- A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.
- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
- C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
- D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.
- E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- I. Return: To give back reusable items or unused products to vendors for credit.

- J. Reuse: To reuse a construction waste material in some manner on the project site.
- K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
 - 1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
 - 2. Submit Report on a form acceptable to Owner.
 - 3. Landfill Disposal: Include the following information:
 - a. Identification of material.
 - b. Amount, in tons or cubic yards (cubic meters), of trash/waste material from the project disposed of in landfills.
 - c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - 4. Incinerator Disposal: Include the following information:
 - a. Identification of material.
 - b. Amount, in tons or cubic yards (cubic meters), of trash/waste material from the project delivered to incinerators.
 - c. State the identity of incinerators, total amount of fees paid to incinerator, and total disposal cost.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - 5. Recycled and Salvaged Materials: Include the following information for each:
 - a. Identification of material, including those retrieved by installer for use on other projects.

- b. Amount, in tons or cubic yards (cubic meters), date removed from the project site, and receiving party.
 - c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
6. Material Reused on Project: Include the following information for each:
- a. Identification of material and how it was used in the project.
 - b. Amount, in tons or cubic yards (cubic meters).
 - c. Include weight tickets as evidence of quantity.
7. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 3 EXECUTION

2.1 WASTE MANAGEMENT PROCEDURES

- A. See Section 01 3000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.
- B. See Section 01 5000 for additional requirements related to trash/waste collection and removal facilities and services.

2.2 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.
- B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect/Engineer.
- C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
- D. Meetings: Discuss trash/waste management goals and issues at project meetings.
 - 1. Prebid meeting.
 - 2. Preconstruction meeting.
 - 3. Regular job-site meetings.
- E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
 - 1. Provide containers as required.
 - 2. Provide adequate space for pick-up and delivery and convenience to subcontractors.

- 3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
- F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.
- G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
- H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
- I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION

**SECTION 01 7800
CLOSEOUT SUBMITTALS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Project record documents.
- B. Operation and maintenance data.
- C. Warranties and bonds.

1.2 RELATED REQUIREMENTS

- A. Section 01 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Individual Product Sections: Specific requirements for operation and maintenance data.
- C. Individual Product Sections: Warranties required for specific products or Work.

1.3 SUBMITTALS

- A. Project Record Documents: Submit documents to Architect/Engineer with claim for final Application for Payment.
- B. Operation and Maintenance Data:
 - 1. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 - 2. Submit one electronic copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned, with Architect/Engineer comments. Revise content of all document sets as required prior to final submission.
 - 3. Submit two printed sets and one electronic set of revised final documents in final form within 10 days after final inspection.
- C. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Addenda.
 - 3. Change Orders and other modifications to the Contract.
 - 4. Reviewed shop drawings, product data, and samples.
 - 5. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
 - 1. Measured depths of foundations in relation to finish first floor datum.
 - 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 3. Field changes of dimension and detail.
 - 4. Details not on original Contract drawings.

3.2 OPERATION AND MAINTENANCE DATA

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.3 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 - 1. Description of unit or system, and component parts.
 - 2. Identify function, normal operating characteristics, and limiting conditions.
 - 3. Include performance curves, with engineering data and tests.
 - 4. Complete nomenclature and model number of replaceable parts.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

- C. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- D. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- E. Provide servicing and lubrication schedule, and list of lubricants required.
- F. Include manufacturer's printed operation and maintenance instructions.
- G. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- H. Additional Requirements: As specified in individual product specification sections.

3.4 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

- A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
- B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
- C. Binders: Commercial quality, 8-1/2 by 11 inch (216 by 280 mm) three D side ring binders with durable plastic covers; 2 inch (50 mm) maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect/Engineer, Consultants, Contractor and subcontractors, with names of responsible parties.
- F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
- G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- J. Arrangement of Contents: Organize each volume in parts as follows:
 - 1. Project Directory.
 - 2. Table of Contents, of all volumes, and of this volume.
 - 3. Operation and Maintenance Data: Arranged by system, then by product category.
 - a. Source data.
 - b. Product data, shop drawings, and other submittals.
 - c. Operation and maintenance data.

- d. Field quality control data.
- e. Photocopies of warranties and bonds.

3.5 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.

END OF SECTION

**SECTION 08 1216
ALUMINUM DOOR FRAMES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aluminum door frames for doors specified in Section 08 1613 – Fiberglass Doors.
- B. Weatherstripping.

1.2 RELATED REQUIREMENTS

- A. Section 08 1613 – Fiberglass Doors: Doors in Aluminum Frames
- B. Section 08 4313 - Aluminum-Framed Storefronts: Windows.
- C. Section 08 7100 - Door Hardware: Hardware items other than specified in this section.

1.3 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; American Architectural Manufacturers Association; 2015.
- B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; 2020.
- C. AAMA 612 - Voluntary Specification, Performance Requirements and Test Procedures for Combined Coatings of Anodic Oxide and Transparent Organic Coatings on Architectural Aluminum; 2017a.
- D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric] ; 2021.
- G. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.

1.5 SUBMITTALS

- A. See Section 01 3000 for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, and field welding if required.
- D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Company specializing in manufacturing aluminum glazing systems with minimum 5 years of documented experience.
- B. Installer's Qualifications: Firm with documented experience in installing components of the types specified.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.8 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.9 WARRANTY

- A. See Division 01 for additional warranty requirements.
- B. Provide 10 year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Flush aluminum door frames:
 - 1. Special-Lite; SL-16: www.special-lite.com
 - 2. C.R. Laurence Co., Inc.; U.S. Aluminum; Series 1000: www.crl-arch.com
 - 3. Cross Aluminum Products, Inc.; Series FL400, E4500: www.crossaluminum.com
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.2 ALUMINUM FRAMES

- A. Aluminum Framing Members: Extruded aluminum shapes, not less than 0.062 inch (1.6 mm) thick, reinforced at hinge and strike locations. Provide drainage holes and internal weep drainage system and corner brackets.
 - 1. Stops: Snap-In heavy duty stops with grooved channel able to accept weatherstripping.
- B. Dimensions: Frame profile.
 - 1. Thickness: 2 inches, nominal.
 - 2. Depth: 4-1/2 inches, nominal.
 - 3. Dimensional Clearances:
 - a. Hinge and Lock Stiles: 0.125 inch (3.2 mm).
 - b. At Top Rail: 0.125 inch (3.2 mm).

2.3 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Fasteners: Stainless steel.
- C. Exposed Flashings: Aluminum sheet, 20 gage, 0.032 inch minimum thickness; finish to match framing members.
- D. Concealed Flashings: Stainless steel, 26 gage, 0.0187 inch minimum thickness.
- E. Sealant for Setting Thresholds: Non-curing butyl type.
- F. Perimeter Sealant: Type polyurethane as specified in Section 07 9200.

2.4 FINISHES

- A. Class I Anodized Finish: AAMA 611 AA-M12C22A41 Colored anodic coating not less than 0.7 mils thick on exterior framing.
 - 1. Color: Dark bronze.

2.5 HARDWARE

- A. For each door, include weather stripping.
- B. Other Door Hardware: As specified in Section 08 7100.
- C. Weather Stripping: Wool pile, continuous and replaceable; provide on all doors.

2.6 ACCESSORIES

- A. Fasteners: Aluminum, non-magnetic stainless steel or other material warranted by manufacturer as non-corrosive and compatible with components of their system.
- B. Brackets and Reinforcements: Manufacturer's high-strength aluminum plates and extrusions in locations required in specifications, as feasible, otherwise, non-magnetic stainless steel or other material suitable for imposed loads on components.
- C. Bituminous Coating: Cold-applied asphaltic mastic installed at 30 mil (0.76 mm) thickness, applied to surfaces of framing members as specified or required by manufacturer's recommendations.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and plastic shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances , aligning with adjacent work.
- E. Install hardware using templates provided.
 - 1. See Section 08 7100 for hardware installation requirements.

- F. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.2 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 1/16 inches per 10 ft, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.3 ADJUSTING

- A. Adjust operating hardware for smooth operation.

3.4 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- C. Remove excess sealant by method acceptable to sealant manufacturer.

3.5 PROTECTION

- A. Protect installed products from damage during subsequent construction.

END OF SECTION

**SECTION 08 1613
FIBERGLASS DOORS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fiberglass reinforced plastic (FRP) doors for installation in aluminum frames.

1.2 RELATED REQUIREMENTS

- A. Section 08 1216 – Aluminum Door Frames: Door Frames for FRP Doors.
- B. Section 08 7100 - Door Hardware: Other door hardware.

1.3 REFERENCE STANDARDS

- A. ANSI A250.4 - American National Standard Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcings; 2018.
- B. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2018.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard details, installation instructions, and hardware and anchor recommendations.
- C. Shop Drawings: Show layout and profiles; include assembly methods.
 - 1. Indicate product components, including hardware reinforcement locations and preparations, accessories, finish colors, patterns, and textures.
 - 2. Indicate wall conditions, door and frame elevations, sections, materials, gages, finishes, location of door hardware by dimension, and details of openings; use same reference numbers indicated on Drawings to identify details and openings.
- D. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer; include detailed terms of warranty.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than Five years of documented experience.
- B. Installer Qualifications: Company specializing in installing products of the type specified in this section with not less than three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

- B. Store materials in original packaging, under cover, protected from exposure to harmful weather conditions and from direct contact with water.
 - 1. Store at temperature and humidity conditions recommended by manufacturer.
 - 2. Do not use non-vented plastic or canvas shelters.
 - 3. Immediately remove wet wrappers.
- C. Store in position recommended by manufacturer, elevated minimum 4 inches above grade, with minimum 1/4 inches space between doors.

1.7 FIELD CONDITIONS

- A. Do not install doors until structure is enclosed.
- B. Maintain temperature and humidity at manufacturer's recommended levels during and after installation of doors.

1.8 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide ten (10) year manufacturer warranty covering materials and workmanship, including degradation or failure due to chemical contact.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Molded Fiberglass Doors:
 - 1. ChemPruf Door Company, Ltd: www.chem-pruf.com.
 - 2. Tiger Door : www.tigerdoor.com.
 - 3. Special-Lite: www.special-lite.com.
 - 4. Phoenix Door Systems: www.phoenixdoorsystems.com.
 - 5. Corrim Company: corrim.com.
 - 6. Substitutions: See Section 01 2500.

2.2 DOOR AND FRAME ASSEMBLIES

- A. Door and Frame Assemblies: Factory-fabricated, prepared and machined for hardware.
 - 1. Mechanical Durability: Tested to ANSI A250.4 Level A (1,000,000 cycles), minimum; tested with hardware and fasteners intended for use on project.
 - 2. Screw-Holding Capacity: Tested to 890 pounds (404 kg), minimum.
 - 3. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less; when tested in accordance with ASTM E84.
 - 4. Flammability: Self-extinguishing when tested in accordance with ASTM D635.
 - 5. Chemical Resistance: Resist degradation due to exposure to tap water, distilled water, and:
 - a. Salt/Brine solution from Ice-Melt materials.
 - 6. Sizes: As indicated on drawings.

7. Clearance Between Door and Frame: 1/8 inch, maximum.
8. Clearance Between Bottom of Door and Finished Floor: 3/4 inch (19 mm), maximum; not less than 1/4 inch (6 mm) clearance to threshold.

2.3 COMPONENTS

- A. Doors: Through-color gel coating on fiberglass reinforced polyester resin construction with reinforced core.
 1. Thickness: 1-3/4 inches, overall.
 2. Subframe and Reinforcements: Fiberglass pultrusions or polymer foam; no metal or wood.
 3. Waterproof Integrity: All edges, cut-outs, and hardware preparations factory fabricated of fiberglass reinforced plastic; provide cut-outs with joints sealed independently of glazing or louver inserts or trim.
 4. Hardware Preparations: Factory reinforce, machine, and prepare for all hardware including field installed items; provide solid blocking for each hardware item; make field cutting, drilling or tapping unnecessary; obtain manufacturer's templates for hardware preparations.
 5. Gel Coating: Ultraviolet stabilized polyester, marine grade NPG-isophthalic, with slightly textured semi-gloss final finish.
 6. Gel Coating Thickness: Minimum 15 mils wet, plus/minus 3 mils.
- B. Frames: Profiles and dimensions as indicated on drawings.
 1. Reference frames as specified in Section 08 1116 – Aluminum Door Frames:
 - a. Confirm stops and hinge placements are coordinated between specification sections.
- C. Hinge and Hardware Fasteners: Stainless steel, Type 304; wood screws.

2.4 PERFORMANCE REQUIREMENTS

- A. Provide door assemblies that have been designed and fabricated in compliance with specified performance requirements.
- B. Water Leakage: No uncontrolled leakage on interior face when tested in accordance with ASTM E331 at differential pressure of 7.5 psf (359 Pa).
- C. Air Leakage: Maximum of 0.1 cfm per square foot at 6.27 psf (0.5 L/sec/sq m at 300 Pa) differential pressure, when tested in accordance with ASTM E283.
- D. Structural Performance: Withstand positive and negative wind loads equal to 1.5 times design wind loads specified by local code without damage or permanent set, when tested in accordance with ASTM E330/E330M, using 10 second duration of maximum load.
- E. Thermal Transmittance, Exterior Doors: AAMA 1503, U-value of 0.35, maximum, measured on exterior door in size required for this project.

2.5 FINISHES

- A. Gel Coating: Ultraviolet (UV) stabilized polyester finish.
 1. Thickness: Minimum 15 mils, 0.015 inch (0.38 mm) wet thickness, plus/minus 3 mils, 0.003 inch (0.07 mm).
 2. Color: As selected by Architect/Engineer from manufacturer's standard line of colors.

2.6 HARDWARE

- A. Door Hardware: See Section 08 7100.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify actual dimensions of openings by field measurements before door fabrication; show recorded measurements on shop drawings.
- B. Do not begin installation until substrates have been properly prepared.

3.2 PREPARATION

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Clean and prepare substrate in accordance with manufacturer's directions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions; do not penetrate frames with anchors.
- B. Set units plumb, level, and true-to-line, without warping or racking doors, and with specified clearances; anchor in place.

3.4 ADJUSTING

- A. Lubricate, test, and adjust doors to operate easily, free from warp, twist or distortion, and to fit watertight for entire perimeter.
- B. Adjust hardware for smooth and quiet operation.
- C. Adjust doors to fit snugly and close without sticking or binding.

3.5 CLEANING

- A. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.

3.6 PROTECTION

- A. Protect installed products from damage during subsequent work.

END OF SECTION

**SECTION 08 3613
SECTIONAL DOORS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Overhead sectional doors, electrically operated.
- B. Operating hardware and supports.
- C. Electrical controls.

1.2 RELATED REQUIREMENTS

- A. Section 13 4345 - Modular Precast Concrete Structures: Precast structure of which this work is a part of.

1.3 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.
- B. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
- C. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- D. DASMA 102 - American National Standard Specifications for Sectional Doors; 2018.
- E. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).
- F. NEMA MG 00001 - Motors and Generators; 2024.
- G. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.
- C. Product Data: Show component construction, anchorage method, and hardware.
- D. Manufacturer's Installation Instructions: Include any special procedures required by project conditions.
- E. Maintenance Data: Include data for motor and transmission, shaft and gearing, lubrication frequency, spare part sources.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.6 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for warranty requirements.
- B. Extended Correction Period: Correct defective work within a 2-year period commencing on Date of Substantial Completion.
- C. Manufacturer Warranty: Provide 5-year manufacturer warranty for electric operating equipment. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Sectional Doors:
 - 1. Clopay Building Products: www.clopaydoor.com/#sle.
 - 2. Overhead Door Corporation: www.overheaddoor.com/#sle.
 - 3. Raynor Garage Doors: www.raynor.com/#sle.
 - 4. Wayne-Dalton, a Division of Overhead Door Corporation: www.wayne-dalton.com/#sle.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.

2.2 PERFORMANCE REQUIREMENTS

- A. Performance: Withstand positive and negative wind loads equal to 1.5 times design wind loads specified by local code without damage or permanent set, when tested in accordance with ASTM E330/E330M, using 10 second duration of maximum load.
- B. Air Leakage Rate: Less than 0.40 cfm/sq ft (2 L/sec/sq m) when tested in accordance with ASTM E283/E283M at test pressure difference of 1.57 psf (75 Pa).
- C. Thermal Transmittance: U-factor (Usi-factor) of 0.31 Btu/hr sq ft degrees F (1.76 W/sq m K), maximum, in accordance with DASMA 102.

2.3 STEEL DOORS

- A. Doors: Flush steel, insulated; standard lift operating style with track and hardware; complying with DASMA 102, Commercial application.
 - 1. Size: 7 feet wide by 7 feet tall.
 - 2. Door Panels: Steel construction; outer steel sheet of 26 gauge, 0.016 inch (0.41 mm) minimum thickness, flush profile; inner steel sheet of 20 gauge, 0.0359 inch (0.91 mm) minimum thickness, flat profile; sheet steel roll formed to channel shape, rabbeted weather joints at meeting rails; polyurethane insulation.
 - 3. Door Nominal Thickness: 2 inches (51 mm) thick.
 - 4. Exterior Finish:
 - a. Factory finished with acrylic baked enamel; color as selected by Architect.

- 5. Interior Finish:
 - a. Factory finished with powder coated finish; color as selected from manufacturer's standard line.
- 6. Electric Operation: Electric control station.

2.4 COMPONENTS

- A. Track: Galvanized steel angles, 0.094 inch (2.4 mm) minimum thickness; 2-5/16 x 4 inch (59 x 102 mm) size, continuous one piece per side; galvanized steel mounting brackets 1/4 inch (6 mm) thick.
- B. Hinge and Roller Assemblies: Heavy duty hinges and adjustable roller holders of galvanized steel; floating hardened steel bearing rollers, located at top and bottom of each panel, each side.
- C. Lift Mechanism: Torsion spring on cross head shaft, with braided galvanized steel lifting cables.
- D. Sill Weatherstripping: Resilient hollow rubber strip, one piece; fitted to bottom of door panel, full length contact.
- E. Jamb Weatherstripping: Roll formed steel section full height of jamb, fitted with resilient weatherstripping, placed in moderate contact with door panels.
- F. Head Weatherstripping: EPDM rubber seal, one piece full length.
- G. Panel Joint Weatherstripping: Neoprene foam seal, one piece full length.
- H. Lock: Inside mounted, adjustable keeper, spring activated latch bar with feature to retain in locked or retracted position; interior handle.
- I. Lock Cylinders: See Section 08 7100.

2.5 MATERIALS

- A. Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating, plain surface.
- B. Insulation: Foamed-in-place polyurethane, bonded to facing.

2.6 ELECTRIC OPERATION

- A. Operator, Controls, Actuators, and Safeties: Comply with UL 325; provide products listed by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction.
 - 1. Provide interlock switches on motor operated units.
- B. Electric Operators:
 - 1. Mounting: Side mounted on cross head shaft.
 - 2. Motor Enclosure:
 - a. Exterior Doors: NEMA MG 00001, Type 4; open drip proof.
 - 3. Motor Rating: 1/2 hp (375 W); continuous duty.
 - 4. Motor Voltage: 120 volts, single phase, 60 Hz.
 - 5. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
 - 6. Controller Enclosure: NEMA EN 10250, Type 1.

7. Opening Speed: 12 inches per second (300 mm/s).
8. Brake: Adjustable friction clutch type, activated by motor controller.
9. Manual override in case of power failure.
10. See Section 26 0583 for electrical connections.
- C. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated; enclose terminal lugs in terminal box sized to comply with NFPA 70.
- D. Control Station: Provide standard three button (Open-Close-Stop) momentary-contact control device for each operator complying with UL 325.
 1. 24 volt circuit.
 2. Surface mounted, at interior door jamb.
 3. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.
- E. Safety Edge: Located at bottom of sectional door panel, full width; electro-mechanical sensitized type, wired to stop and reverse door direction upon striking object; hollow neoprene covered to provide weatherstrip seal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.
- B. Verify that electric power is available and of the correct characteristics.

3.2 PREPARATION

- A. Prepare opening to permit correct installation of door unit to perimeter air and vapor barrier seal.
- B. Apply primer to wood frame.

3.3 INSTALLATION

- A. Install door unit assembly in accordance with manufacturer's instructions.
- B. Anchor assembly to wall construction and building framing without distortion or stress.
- C. Securely brace door tracks suspended from structure. Secure tracks to structural members only.
- D. Fit and align door assembly including hardware.
- E. Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.

3.4 TOLERANCES

- A. Maximum Variation from Plumb: 1/16 inch (1.5 mm).
- B. Maximum Variation from Level: 1/16 inch (1.5 mm).
- C. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch (3 mm) from 10 ft (3 m) straight edge.

D. Maintain dimensional tolerances and alignment with adjacent work.

3.5 ADJUSTING

A. Adjust door assembly for smooth operation and full contact with weatherstripping.

3.6 CLEANING

A. Clean doors and frames and glazing.

B. Remove temporary labels and visible markings.

3.7 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

B. Do not permit construction traffic through overhead door openings after adjustment and cleaning.

END OF SECTION

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**SECTION 08 4313
ALUMINUM-FRAMED STOREFRONTS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.

1.2 RELATED REQUIREMENTS

- A. Section 07 9200 - Joint Sealants: Sealing joints between frames and adjacent construction.
- B. Section 08 8000 - Glazing: Glass and glazing accessories.

1.3 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.
- B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.
- C. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
- D. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
- G. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- H. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
- I. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, and internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
- D. Samples: Submit two samples 3 by 2 inches (75 by 50 mm) in size illustrating finished aluminum surface.
- E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Manufacturer and Installer Qualifications: Company specializing in manufacturing aluminum glazing systems with minimum three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.7 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

1.8 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

PART 2 PRODUCTS

2.1 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

- A. Center-Set Style, Thermally-Broken:
 - 1. Basis of Design: EFCO Corporation; Series 403T, Thermal Storefront Framing.
 - 2. Vertical Mullion Dimensions: 1-3/4 inches wide by 4-1/2 inches deep (45 mm wide by 114 mm deep).
- B. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
 - 1. Kawneer North America; 451T Storefront: www.kawneer.com/#sle.
 - 2. Oldcastle Building Envelope; Series 3000s: www.oldcastlebe.com/#sle.
 - 3. Tubelite Inc.; T1400 Series: tubeliteinc.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.2 STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. Glazing Rabbet: For 1 inch (25 mm) insulating glazing.
 - 2. Finish: Class I color anodized.
 - a. Factory finish all surfaces that will be exposed in completed assemblies.
 - b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
 - 3. Finish Color: Color to be selected.

4. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
 7. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
 8. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
 9. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
- B. Performance Requirements:
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - a. Design Wind Loads: Comply with requirements of ASCE 7.
 - b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
 2. Water Penetration Resistance: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8.00 lbf/sq ft (390 Pa).
 3. Air Leakage: Maximum of 0.06 cu ft/min/sq ft (0.3 L/s/sq m) of wall area, when tested in accordance with ASTM E283 at 6.27 pounds per square foot (300 Pa) pressure differential across assembly.
 4. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.

2.3 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
1. Glazing stops: Flush.
 2. Cross-Section: 2 x 4 1/2 inch (51 x 114 mm) nominal dimension.
- B. Glazing: As specified in Section 08 8000.

2.4 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Fasteners: Stainless steel.
- C. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

- D. Glazing Accessories: As specified in Section 08 8000.

2.5 FINISHES

- A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils (0.018 mm) thick.
- B. Color: Color to be selected.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.2 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- G. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for independent testing and inspection requirements. Inspection will monitor quality of installation and glazing.

3.4 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

3.5 PROTECTION

- A. Protect installed products from damage during subsequent construction.

END OF SECTION

SECTION 08 7100 DOOR HARDWARE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Hardware for aluminum doors.
- B. Thresholds.

1.2 RELATED REQUIREMENTS

- A. Section 08 1216 - Aluminum Door Frames.

1.3 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. BHMA A156.2 - American National Standard for Bored and Preamsembled Locks & Latches; 2017.
- C. BHMA A156.4 - American National Standard for Door Controls - Closers; 2013.
- D. BHMA A156.8 - American National Standard for Door Controls - Overhead Stops and Holders; 2015.
- E. BHMA A156.18 - American National Standard for Materials and Finishes; 2016.
- F. BHMA A156.21 - American National Standard for Thresholds; 2014.
- G. BHMA A156.22 - American National Standard for Door Gasketing and Edge Seal Systems, Builders Hardware Manufacturers Association; 2017.
- H. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames; 2004.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the manufacture, fabrication, and installation of products onto which door hardware will be installed.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project.
- C. Hardware Schedule: Detailed listing of each item of hardware to be installed on each door. Use door numbering scheme as included in the Contract Documents. Identify electrically operated items and include power requirements.
- D. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
- E. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

- F. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.

1.6 QUALITY ASSURANCE

- A. Hardware Supplier Personnel: Employ an Architectural Hardware Consultant (AHC) to assist in the work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Package hardware items individually; label and identify each package with door opening code to match hardware schedule.

1.8 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide five year warranty for door closers.

PART 2 PRODUCTS

2.1 DOOR HARDWARE - GENERAL

- A. Provide all hardware specified or required to make doors fully functional, compliant with applicable codes, and secure to the extent indicated.
B. Provide all items of a single type of the same model by the same manufacturer.
C. Provide products that comply with the following:
1. Applicable provisions of federal, state, and local codes.
D. Finishes: Provide door hardware of the same finish unless otherwise indicated.
1. Primary Finish: Satin chrome plated over nickel on brass or bronze, 626 (approx. US26D).
2. Finish Definitions: BHMA A156.18.
3. Exceptions:
a. Where base metal is specified to be different, provide finish that is an appearance equivalent according to BHMA A156.18.
b. Door Closer Covers and Arms: Color to be selected by Architect/Engineer from manufacturer's standard colors.

2.2 HINGES

- A. Hinges: Provide hinges on every swinging door.
1. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
2. Provide ball-bearing hinges at all doors having closers.
3. Provide hinges in the quantities indicated.
4. Provide non-removable pins on exterior out-swinging doors.
5. Material: Stainless steel.

B. Quantity of Hinges Per Door:

1. Doors From 60 inches (1.5 m) High up to 90 inches (2.3 m) High: Three hinges.

C. Manufacturers - Hinges:

1. Assa Abloy McKinney: www.assaabloydss.com.
2. Bommer Industries, Inc: www.bommer.com/#sle.
3. Stanley Black & Decker: www.stanleyblackanddecker.com.
4. Substitutions: See Section 01 6000 - Product Requirements.

2.3 FLUSH BOLTS

A. Flush Bolts: Comply with BHMA A156.16, Grade 1.

1. Flush Bolt Throw: 3/4 inch (19 mm), minimum.
2. Provides extension bolts in leading edge of door, one bolt into floor, one bolt into top of frame.
 - a. Pairs of Swing Doors: At inactive leaves, provide flush bolts of type as required to comply with code.
3. Manual Flush Bolts: Provide lever extensions for top bolt at over-sized doors.

2.4 LOCKS AND LATCHES

A. Locks: Provide a lock for every door, unless specifically indicated as not requiring locking.

1. Hardware Sets indicate locking functions required for each door.
2. Trim: Provide lever handle or pull trim on outside of all locks unless specifically stated to have no outside trim.
3. Lock Cylinders: Provide key access on outside of all locks unless specifically stated to have no locking or no outside trim.

B. Lock Cylinders: Manufacturer's standard tumbler type, six-pin standard core.

1. Provide cams and/or tailpieces as required for locking devices required.

C. Keying: Master keyed. Coordinate with Owner's existing system.

2.5 CYLINDRICAL LOCKSETS

A. Locking Functions: As defined in BHMA A156.2, and as follows.

1. Privacy: F76, emergency tool unlocks.
 - a. Keyed Occupancy Indicator: Vacant/Occupied
2. Always-Locked: F86, key required to lock, may not be left unlocked.

B. Manufacturers - Cylindrical Locksets:

1. Assa Abloy Corbin Russwin, ML2000: www.assaabloydss.com.
2. Corbin Russwin; an Assa Abloy Group company; ML2000: www.assaabloydss.com/#sle.
3. Schlage, an Allegion brand: www.allegion.com/us.
4. Substitutions: See Section 01 6000 - Product Requirements.

2.6 AUXILIARY LOCKS (DEADLOCKS)

- A. Auxiliary Locks (Deadlocks): Comply with BHMA A156.36, Grade 1.
 - 1. Type: Bored (cylindrical).
 - 2. Backset: 2-3/4 inch (70 mm), unless otherwise indicated.
 - 3. Bolt Throw: 1/2 inch (12.7 mm), with latch made of hardened steel.
 - 4. Provide strike that matches frame.
- B. Manufacturers:
 - 1. Corbin Russwin; an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 2. Schlage, an Allegion brand: www.allegion.com/us.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.

2.7 CLOSERS

- A. Closers: Complying with BHMA A156.4.
 - 1. Provide surface-mounted, door-mounted closers unless otherwise indicated.
 - 2. Provide a door closer on every exterior door.
 - 3. Provide hold-open and stop function on the arm of each closer.
- B. Manufacturers - Closers:
 - 1. Assa Abloy Corbin Russwin, Norton, Rixson, Sargent, or Yale: www.assaabloydss.com.
 - 2. Hager Companies: www.hagerco.com.
 - 3. LCN, an Allegion brand: www.allegion.com/us.

2.8 ASTRAGALS

- A. Astragals are provided by aluminum door and frame manufacturer.

2.9 GASKETING AND THRESHOLDS

- A. Gasketing is provided by aluminum door and frame manufacturer.
- B. Thresholds: Complying with BHMA A156.21.
 - 1. At each exterior door, provide a threshold unless otherwise indicated.
 - 2. Field cut threshold to frame for tight fit.
- C. Manufacturers:
 - 1. Assa Abloy McKinney: www.assaabloydss.com.
 - 2. Hager Companies: www.hagerco.com.
 - 3. Pemko Manufacturing Co: www.pemko.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.10 PROTECTION PLATES AND ARCHITECTURAL TRIM

- A. Protection Plates:
 - 1. Kickplate: Provide on push side of every door with closer, except storefront and all-glass doors.

2. Material: Stainless steel.
- B. Manufacturers - Protection Plates and Architectural Trim:
 1. Assa Abloy McKinney: www.assaabloydss.com.
 2. Hiawatha, Inc: www.hiawathainc.com.
 3. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that doors and frames are ready to receive work; labeled, fire-rated doors and frames are present and properly installed, and dimensions are as indicated on shop drawings.
- B. Verify that electric power is available to power operated devices and of the correct characteristics.

3.2 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and applicable codes.
- B. Use templates provided by hardware item manufacturer.
- C. Install hardware on fire-rated doors and frames in accordance with code and NFPA 80.
- D. Mounting heights for hardware from finished floor to center line of hardware item:
 1. For steel doors and frames: Comply with DHI "Recommended Locations for Architectural Hardware for Steel Doors and Frames."
- E. Set exterior door thresholds with full-width bead of elastomeric sealant on each point of contact with floor; anchor thresholds with stainless steel countersunk screws.

3.3 ADJUSTING

- A. Adjust work under provisions of Section 01 7000.
- B. Adjust hardware for smooth operation.

3.4 PROTECTION

- A. Protect finished Work under provisions of Section 01 7000.
- B. Do not permit adjacent work to damage hardware or finish.

HARDWARE SETS

HW-1: LEVER LATCHSET (F76), PRIVACY WITH INDICATOR

FOR DOORS TO SHOWER COMPARTMENTS (8 THUS)

3 HINGES

1 LOCKSET, PRIVACY

1 OCCUPANCY INDICATOR

1 DEADLOCK WITH THUMB TURN

1 CLOSER W/ COVER, STOP AND HOLD-OPEN FUNCTION

1 THRESHOLD

1 KICK PLATE

1 WEATHERSTRIPPING (BY DOOR MANUFACTURER)

1 DOOR SWEEP (BY DOOR MANUFACTURER)

HW-2: LEVER LOCKSET (F86)

FOR SINGLE DOORS TO MECHANICAL SPACE (2 THUS)

3 HINGES

1 LOCKSET, STOREROOM

1 CLOSER W/ COVER, STOP AND HOLD-OPEN FUNCTION

1 THRESHOLD

1 KICK PLATE

1 WEATHERSTRIPPING (BY DOOR MANUFACTURER)

1 DOOR SWEEP (BY DOOR MANUFACTURER)

HW-3: LEVER LOCKSET (F86)

FOR PAIR OF DOORS TO MECHANICAL SPACE (1 THUS)

3 HINGES

1 LOCKSET, STOREROOM

2 FLUSH BOLTS

2 CLOSER W/ COVER, STOP AND HOLD-OPEN FUNCTION

1 KICK PLATE

1 THRESHOLD

1 ASTRAGAL (BY DOOR MANUFACTURER)

2 DOOR SWEEPS (BY DOOR MANUFACTURER)

1 WEATHERSTRIPPING (BY DOOR MANUFACTURER)

END OF SECTION

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**SECTION 08 8000
GLAZING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Glass.

1.2 REFERENCE STANDARDS

- A. ASTM C1036 - Standard Specification for Flat Glass; 2011.
- B. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- C. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2012a.
- D. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.

1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
- C. Samples: Submit two samples 6 x 6 inch (150 x 150 mm) in size of glass and plastic units, showing coloration and design.

1.4 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Sealed Insulating Glass Units: Provide a five (5) year warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.
- C. Laminated Glass: Provide a five (5) year warranty to include coverage for delamination, including replacement of failed units.

PART 2 PRODUCTS

2.1 INSULATING GLASS UNITS

- A. Acid-Etched Insulating Glass Units: Double glazed.
 - 1. Application: All exterior glazing unless otherwise indicated.
 - 2. Outboard Lite: Fully tempered float glass, 1/4 inch (6 mm) thick, minimum.
 - a. Tint: Clear.
 - b. Coating: Low-E (passive type), on #2 surface.
 - 3. Inboard Lite: Fully tempered float glass, 1/4 inch (6 mm) thick, minimum.
 - a. Tint: Clear.

b. Coating: Walker Textures Satin Acid Etching, on #3 surface.

1) Walker Glass Company Ltd; www.walkerglass.com.

4. Total Thickness: 1 inch (25 mm).

5. Total Solar Heat Gain Coefficient: 0.40, maximum.

6. Glazing Method: Gasket glazing.

2.2 EXTERIOR GLAZING ASSEMBLIES

A. Performance Criteria: Select type and thickness of glass to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of glass.

1. Design Pressure: Calculated in accordance with applicable codes.

2. Use the procedure specified in ASTM E1300 to determine glass type and thickness.

3. Limit glass deflection to 1/200 or flexure limit of glass, whichever is less, with full recovery of glazing materials.

4. Glass thicknesses listed are minimum.

2.3 GLASS MATERIALS

A. Float Glass: All glazing is to be float glass unless otherwise indicated.

1. Fully Tempered Types: ASTM C1048.

2. Thicknesses: As indicated; for exterior glazing comply with specified requirements for wind load design regardless of specified thickness.

B. Acid Etched Glass:

1. Pattern: Full Face, Satin.

2. Manufacturers:

a. Walker Glass Company Ltd; www.walkerglass.com.

b. Substitutions: Refer to Section 01 6000 - Product Requirements.

2.4 INSULATING GLASS UNITS

A. Insulating Glass Units: Types as indicated.

1. Durability: Certified by an independent testing agency to comply with ASTM E2190.

2. Edge Spacers: Aluminum, bent and soldered corners.

3. Edge Seal: Glass to elastomer with supplementary silicone sealant.

4. Purge interpane space with dry hermetic air.

2.5 GLAZING ACCESSORIES

A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) x width of glazing rabbet space minus 1/16 inch (1.5 mm) x height to suit glazing method and pane weight and area.

B. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; black color.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

3.2 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant.

3.3 INSTALLATION - EXTERIOR/INTERIOR DRY METHOD (GASKET GLAZING)

- A. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.
- B. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- C. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.4 CLEANING

- A. Remove glazing materials from finish surfaces.
- B. Remove labels after Work is complete.
- C. Clean glass and adjacent surfaces.

END OF SECTION

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**SECTION 10 4400
FIRE PROTECTION SPECIALTIES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fire extinguishers.

1.2 REFERENCE STANDARDS

- A. FM (AG) - FM Approval Guide; current edition.
- B. NFPA 10 - Standard for Portable Fire Extinguishers; 2026.
- C. UL (DIR) - Online Certifications Directory; Current Edition.

1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide extinguisher operational features.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Fire Extinguishers:
 - 1. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com/#sle.
 - 2. Larsen's Manufacturing Co: www.larsensmfg.com/#sle.
 - 3. Kidde, a unit of United Technologies Corp: www.kidde.com/#sle.
 - 4. Potter-Roemer: www.potterroemer.com/#sle.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.

2.2 FIRE EXTINGUISHERS

- A. General Requirements: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
 - 1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated on drawings.
- B. Multipurpose Dry-Chemical-Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
 - 1. Cartridge Operated: Spun shell.
 - 2. Class: A:B:C.
 - 3. Size: 10 pound (4.54 kg).
 - 4. Finish: Baked polyester powder coat, red color.
 - 5. Temperature range: Minus 65 degrees F (Minus 54 degrees C) to 120 degrees F (49 degrees C).

2.3 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, chrome-plated.
- B. Wall Signs: V-shaped sign with red arrow pointing down and lettering "Fire Extinguisher".
 - 1. Provide one sign for each fire extinguisher.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Locate fire extinguisher on the Mechanical room wall, where directed by Architect.
- C. Install extinguishers plumb and level, 36 inches (914 mm) from finished floor to bottom of extinguisher.
- D. Install brackets on walls, 48 inches (1371 mm) from finished floor to top of extinguisher at location directed by Architect.
- E. Install cabinet signage directly above extinguisher at 84 inches above floor.

END OF SECTION

**SECTION 13 4345
MODULAR PRECAST CONCRETE STRUCTURES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Modular Precast Concrete Structures.

1.2 RELATED REQUIREMENTS

- A. Section 08 1116 - Aluminum Doors and Frames: for swinging doors to be provided under the work of this Section.
- B. Section 08 1216 - Aluminum Door Frames
- C. Section 08 1613 - Fiberglass Doors
- D. Section 08 3613 - Sectional Doors: for overhead doors to be provided under the work of this Section.
- E. Section 08 4313 - ALUMINUM-FRAMED STOREFRONTS
- F. Section 08 7100 - DOOR HARDWARE.
- G. 08 8000 - GLAZING

1.3 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.
- C. ICC (IECC)-2012 - International Energy Conservation Code; 2012.
- D. ITS (DIR) - Directory of Listed Products; Current Edition.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL (DIR) - Online Certifications Directory; Current Edition.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week before the start of work; require attendance by affected installers.
 - 1. Verify building requirements, substrate conditions, utility connections, and manufacturer's installation instructions.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit product data sheets, including material descriptions, dimensions and profiles of components and finishes, and preparation instructions and recommendations.

- C. Shop Drawings: Submit plans, elevations, sections, construction details, and utility connections as necessary for this work.
 - 1. Include design engineer's certification and stamp or seal on shop drawings.
- D. Structural Engineer Certification: Letter signed by a Professional/Structural Engineer, registered to practice in the State of Iowa, verifying compliance with Design Requirements. Letter shall reference specific dead loads, live loads, snow loads, wind loads, tributary area load reductions (if applicable), collateral loads, seismic loads, end use categories, applied soil bearing pressures, and governing building code including edition and load applications. In lieu of a letter, the required information may be provided on the shop drawings.
- E. Manufacturer's qualification statement.
- F. Executed warranty.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Manufacturer shall be an NPCA Certified Plant or equal with verifiable references demonstrating quality, design and service upon request.
- C. Installer Qualifications: Manufacturer of structure.

1.7 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide the following warranties: 20-year structural manufacturer warranty for fabricated structures that fails in materials or workmanship; include coverage for exterior prefinished surfaces against chipping, cracking or crazing, blistering, peeling, chalking, or fading and for weathertightness of building enclosure elements. Complete forms in Owner's name and register with manufacturer.
 - 1. 20-year structural manufacturer warranty for fabricated structures that fails in materials or workmanship.
 - 2. 3-year warranty for defects in paint, caulk, and grout.
 - 3. Manufacturer's warranty on all hardware and components not produced at precast concrete manufacturer's plant

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Modular Precast concrete structures:
 - 1. Huffcutt Concrete: huffcutt.com.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide factory-fabricated modular building capable of withstanding the following loads and stresses without damage or failure.
 - 1. Loads: Comply with applicable ASCE 7 requirements.
 - 2. Member Deflection: Under full live load, maintain maximum deflection of 1/360 of span.
- B. Thermal Movement: Design structure to accommodate thermal movement caused by ambient temperature range of 120 degrees F (67 degrees C) and surface temperature range of 180 degrees F (100 degrees C) without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects on assembly components.
- C. Electrical Components, Devices, and Accessories: Listed and labeled by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction and installed in compliance with NFPA 70 and marked for intended application.

2.3 MODULAR PRECAST CONCRETE STRUCTURES

- A. Application: Shower house, with structure fully factory assembled for freestanding assembly of sections and on-site installation.
 - 1. Base Size: 21.33 by 44.67 feet (6.5 by 13.6 m).
 - 2. Wall Height: 96 inches (2.44 m).
 - 3. Foundation: Concrete.

2.4 COMPONENTS

- A. General: Provide structure that complies with applicable codes for structural integrity, energy efficiency, accessibility, mechanical, plumbing, and electrical systems.
- B. Modules:
 - 1. Two shower/toilet rooms with service chase between: 4 modules; mirror layout of adjacent modules.
 - 2. Mechanical equipment spaces: 3 modules.
- C. Floors:
 - 1. Concrete with smooth trowel finish. Slope floors to drains.
- D. Walls:
 - 1. Insulated precast concrete.
 - a. Wall Makeup: 4 inches concrete, 2 inches insulation, 2 inches concrete.
 - b. Form: Architectural form liner as selected from
 - c. Color: Stain, as selected from manufacturer's available colors.
 - 2. Insulation: Manufacturer's standard, complying with the ICC (IECC)-2012.
- E. Roof:
 - 1. Insulated and sloped to drain at perimeter.
 - 2. Provide minimum roof/ceiling insulation value in compliance with local building code requirements.

3. Roof Configuration: Gable roof, 2/12 pitch.
 - a. Roof Type: Insulated precast concrete.
 - b. Overhang: 8 inches (204 mm).
 - c. Form: Cedar shake architectural form liner as selected from manufacturer's available liners.
 - d. Color: Stain, as selected from manufacturer's available colors.
4. Gutters and Downspouts: None.
- F. Grout: Grout weld plate panel connections flush with interior wall surface. Speed Crete Red Line or equal.
- G. Sealants: Joints between precast panels and around doors and windows shall be caulked using a durable, flexible polyurethane sealant. BASF Sonolastic NP-1 or equal.
- H. Windows: Provide as specified in Section 08 4313 - ALUMINUM-FRAMED STOREFRONTS.
- I. Exterior Doors: Provide swinging doors to each shower compartment; and two single doors and a pair of doors to the mechanical compartments as shown on the drawings.
 1. Provide aluminum frames as specified in Section 08 1216 - Aluminum Door Frames.
 2. Provide fiberglass doors as specified in Section 08 1613 - Fiberglass Doors.
- J. Overhead Door: Provide as specified in Section 08 3613 - Sectional Doors.
- K. Door Hardware: Provide as specified in Section 08 7100 - DOOR HARDWARE
- L. Interior Finishes:
 1. Floors: Siloxane concrete sealer. TK Products; TK290 Series or equal.
 2. Walls: Epoxy paint.
 - a. Application: Concrete walls and ceilings in shower compartments.
 - b. Primer: As recommended by topcoat manufacturer for substrates.
 - c. Two Top Coats: Catalyzed epoxy paint; Semi-Gloss.
- M. Exterior Finishes:
 1. Walls: Concrete stain, color as selected.
 2. Roof: Concrete stain, color as selected.
- N. Toilet Accessories: ADA and ANSI A117.1 compliant size, function, and location.
 1. Toilet Tissue Dispenser: Wall mounted, stainless steel, 3-roll capacity.
 2. Paper Towel Dispenser: Wall mounted adjacent to sink.
 3. Mirror: Wall mounted above sink, stainless steel frame, 18 inches by 36 inches.
 4. Grab Bars: Complying with ANSI A117.1, mounted adjacent to toilet and shower.
 - a. At water closets, provide (1) 18" stainless vertical grab bar, (1) 36" stainless horizontal grab bar, (1) 42" stainless horizontal grab bar.
 - b. At showers, provide (1) 18" stainless vertical grab bar, (1) 30" stainless horizontal grab bar, (1) 42" stainless horizontal grab bar.

5. Shower Seat: Reversible folding, phenolic seat. Bradley Model 9569 or equal.
6. Bench: 42 inches, minimum, long; 20 to 24 inches deep.
7. Coat Hooks: (2) stainless steel.
 - a. Mount one coat hook at 60 inches above floor.
 - b. Mount one coat hook at 48 inches, maximum, above floor.
- O. Plumbing Fixtures: Refer to Plumbing drawings for quantities, locations, and specifications.
- P. Heating/Ventilating/Air Conditioning System: Provided by mechanical contractor. Refer to mechanical drawings and specifications.
- Q. Heating/Air Conditioning (AC) Units: Provided by mechanical contractor.
- R. Electric Power Service: 200 A, 120/240 VAC, single-phase, three-wire.
 1. Electrical Panel: Provide breaker panel with at least 14 circuits; located as indicated on drawings.
 2. Duplex Outlets: Provide at least 14 20 A, 120 VAC duplex receptacles on interior and 3 weatherproof duplex receptacles on exterior.
 3. GFCI Outlets: Provide 120 VAC ground-fault circuit interrupter (GFCI) power duplex receptacle(s) with tester located on exterior at all locations.
- S. Interior Lighting Fixtures: Provide ceiling-mounted, standard light-emitting diode (LED) lighting fixture in each shower room, and 2 fixtures per module in chase and mechanical equipment rooms.
 1. Provide occupancy sensor to control light fixtures in each shower room.
 2. Provide 3-way switches mounted adjacent to entry doors to control light fixtures in mechanical equipment space.
- T. Exterior Lighting Fixtures: Provide wall-mounted, LED white flood light at 120 volts.
 1. Provide 3 fixtures each, on the east and west walls, and one fixture on the north wall.
 2. Provide photoelectric controller for exterior lighting.

2.5 FABRICATION

- A. Fabricate structures in modules in factory, including, but not limited to:
 1. Glazing of windows and doors.
 2. Wiring of electrical systems, made ready for on-site service connection.
 3. Piping of mechanical system, made ready for on-site mechanical service connection.
 4. Other systems, as required, for fully finished, functional, and operational structure.
- B. Separate different adjacent materials using non-conductive tape, paint, or other materials that will not be visible upon completion of this work.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, adjacent areas, and conditions, and supporting foundation, with installer present, for compliance with manufacturer's requirements, including installation tolerances and other conditions affecting performance of work.
- B. Examine installed anchor bolts for accuracy and verify that bearing surfaces are ready to receive work.
- C. Examine rough-in of required electrical and mechanical services prior to placement of structure.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean areas of supporting foundation thoroughly before installation.
- B. Prepare substrate surfaces using methods as recommended by manufacturer under project conditions.

3.3 INSTALLATION

- A. Install structure in accordance with manufacturer's written instructions.
- B. Manufacturer shall place structure on foundation.
- C. Contractor shall make final mechanical connections after the building is placed by manufacturer.
- D. Manufacturer shall seal and finish seams between modules.
- E. Set structure plumb and aligned, baseplates level and true to plane with full bearing on concrete substrate and securely fasten to concrete base with indicated anchorage.
- F. Connection to electrical and mechanical systems to be performed by respective sub-contractors.

3.4 ADJUSTING

- A. Adjust doors and hardware to operate smoothly and properly without binding and verify that locks engage accurately and securely without forcing or binding.
- B. Touch-up, repair, or replace damaged products or exposed finishes before Date of Substantial Completion.

3.5 CLEANING

- A. Clean structure in accordance with manufacturer's written instructions.

END OF SECTION

**SECTION 22 0500
COMMON WORK RESULTS FOR PLUMBING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The work shall include the furnishings of systems, equipment and materials specified in this Division and as called for on the Plumbing Drawings to include supervision, quality control, operation, methods and labor for the fabrication, installation, start-up and tests for the complete plumbing installation. The work shall also include the furnishing of necessary hoisting facilities to set materials and equipment in place and the furnishing of any scaffolding and transportation associated with this work.
- B. Where noted on the drawings or where called for in other sections of the specification, the Contractor for this division shall install equipment furnished by others and shall make required service connections. Verify with the supplier of the equipment the requirements for the installation. This contractor shall be responsible for the removal and installation of railings, piping, ductwork, louvers, etc. as required to install new equipment.

1.2 DAMAGE

- A. The Contractor shall be responsible for damage to the work of other trades, or to the building and its contents, caused by equipment installation.

1.3 PERMITS AND INSPECTIONS

- A. Obtain and furnish necessary permits and inspection certificates for material and labor furnished. Permits and certificates shall be obtained from the proper inspection authorities. The cost of permits, certificates and fees required in connection with the installation shall be borne by the Contractor, unless otherwise noted in the detailed contractual description preceding these specifications. Where applications are required for the procuring of utility services to the building, see that such application is properly filed with the utility, and that information required for such an application is presented to the extent and in the form required by the utility company.

1.4 CODES AND STANDARDS

- A. Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
- B. Applicable provisions of the following codes and standards are hereby imposed on a general basis for the mechanical work in addition to specific applications specified by individual work sections of these specifications.
- C. Any product used for dispensing potable water shall meet NSF 61 and NSF 372 testing standards. Third party testing shall be required.

- D. If any work indicated on the drawings or specified herein conflicts in any way with any of the rules and regulations of the above Authorities, the Contractor shall promptly notify the Architect/Engineer in writing and do so no less than 72 hours before bids are opened. In the event the Contractor fails to notify the Architect/Engineer and changes are required by said conflicts, the Contractor shall make such changes as are required without additional cost to this Owner.
- E. Installations must be safe in every respect and must not create a condition which will be harmful to building occupants; to operating, installing or testing personnel; to workmen; or to the public. The contractor for each installation shall be solely responsible for providing installations which will meet these conditions. If the Contractor believes that the installation will not be safe for all parties, report these beliefs in writing to the Architect/Engineer before any equipment is purchased or work is installed, giving recommendations. The Architect/Engineer will work out required changes and adjustments in contract price where adjustments are warranted.

1.5 DRAWINGS

- A. A complete set of up-to-date Project Drawings and Specifications shall be kept on the site at all times. Prior to installing any of the work, check the drawings for dimensions and see that the work does not interfere with clearance required for ceilings, beams, foundations, finished columns, pilasters, partitions and electrical equipment as shown on the drawings and details. After work is installed and it develops that interferences occur which have not been called to the Architect/Engineer's attention before the installation, the Contractor shall, at his own expense, make such changes in his work as directed by the Architect/Engineer.
- B. The contract drawings for plumbing work are in part diagrammatic, intended to convey the scope of work and indicate general arrangement and approximate sizes and locations of equipment and materials. Where job conditions require reasonable changes in indicated locations and arrangement, the Contractor shall make such changes as directed by the Architect/Engineer, without additional cost to the Owner.
- C. Because of the scale of the drawings, certain basic items such as pipe fittings, access panels, and sleeves may not be shown; but where such items are required by other sections of these specifications or where they are required by the nature of the work, they shall be furnished and installed. Rough-in dimensions and locations shall be verified with the supplier of equipment furnished by other trades, or by the Owner, prior to the time of roughing-in.
- D. Equipment specification may not deal individually with minute items required such as components, parts, controls and devices which may be required to produce the equipment performance specified, or as required to meet the equipment warranties. Where such items are required, they shall be included by the supplier of the equipment, whether or not specifically called for.
- E. The drawings and the specifications are cooperative and supplementary. It is the intent of both said drawings and specifications to cover all mechanical requirements in their entirety as nearly as possible. The Contractor shall closely check the drawings and specifications for any obvious errors or omissions and bring any such condition to the attention of the Architect/Engineer prior to the receipt of bids, in order to permit clarification by means of a mailed Addendum. If there is no question prior to the bid proposal date, the Architect/Engineer shall assume that the drawings and specifications are complete and correct and will expect the intent of said documents to be complied with, and the installation to be complete in all respects, according to said intent.

- F. Locate equipment which must be serviced, operated or maintained in fully accessible positions. Minor deviations from the contract drawings may be made to allow for better accessibility, but changes of magnitude, or which involve extra cost, shall not be made without prior approval. Ample space shall be allowed for removal of parts that may require replacement or service in the future.
- G. All valves, pumps, etc. shall be accessible for maintenance purposes. Locate items carefully and coordinate with other trades so that each valve and piece of equipment is accessible and functional. Items located above a non-accessible ceiling, chase, or soffit shall be accessible through an access door. Coordinate location of access doors with the general contractor.

1.6 RESPONSIBILITY

- A. The Contractor's responsibility shall not end with the installation and connecting of the various apparatus. It shall include the services of an experienced superintendent, who shall be constantly in charge of the work, together with the qualified journeymen, helpers and laborers required to properly unload, install, connect, adjust, start, operate and test the work involved, including equipment and materials furnished by other trades or by the Owner, until such time as the entire plumbing installation functions properly in every detail.

1.7 COORDINATION

- A. Coordinate the work with other trades prior to installation.
- B. No piping or equipment, which is foreign to the electrical equipment, or architectural appurtenances shall be run over the top of any electrical panels or electrical equipment, in accordance with NEC 110.26. This does not prohibit sprinkler protection for the installation.
- C. The determination of quantities of material and equipment required shall be made from the drawings. Schedules on the drawings and in the specifications are completed as an aid, but where discrepancies arise, it shall be the Contractor's responsibility to provide the required quantity.
- D. Where the specifications state that equipment shall be furnished, installed or provided, it shall be understood to mean this Contractor shall furnish and install completely, unless it is specifically stated that the equipment is to be furnished and installed by others.
- E. The Architect/Engineer reserves the right to determine space priority of the contractors in the event of interference between the piping and equipment of the various contractors. Conflicts between the drawings and specifications, or between requirements set forth for the various trades, shall be called to the attention of the Architect/Engineer. If clarification is not asked for prior to the taking of bids, it will be assumed that none is required, and that the Contractor has submitted his bid in conformance with plans and specifications as issued and that no interference exists.

1.8 GUARANTEE AND MAINTENANCE

- A. Materials and equipment shall be guaranteed to be free from defects and to be new equipment; no secondhand, used or salvaged equipment will be allowed. The Owner's existing equipment which is to be relocated or reinstalled under this contract shall be refurbished, cleaned and repaired, and made subject to the guarantee and maintenance as herein specified, unless specifically noted otherwise.
- B. Keep the entire portion of the work in repair, without additional cost to the Owner, so far as defects in workmanship, apparatus, material or construction are concerned for one (1) year from the date of final acceptance, except as otherwise specified herein.

- C. Equipment which fails to meet performance ratings as specified and shown on the drawings shall be removed and replaced by new equipment that meets the specified requirements, without additional cost to the Owner.
- D. Materials and workmanship shall be subject to the review of the Architect/Engineer, in whose presence various tests shall be made as required by these specifications.

PART 3 EXECUTION

2.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- C. Install piping at indicated slopes.
- D. Install fittings for changes in direction and branch connections.
- E. Install piping to allow application of insulation.
- F. Select system components with pressure rating equal to or greater than system operating pressure.

2.2 OPENINGS, CUTTING, AND PATCHING

- A. The General Contractor shall coordinate the placing of openings in the new structure, as required for the installation of the plumbing work.
- B. Furnish to the General Contractor the accurate locations and sizes for required openings. This shall not relieve this Contractor of the responsibility of checking to assure that proper size openings are provided. When additional patching is required due to this Contractor's failure to inspect this work, this Contractor shall make arrangements for the patching required to properly close the opening, to include patch painting. This Contractor shall pay any additional cost incurred in this respect.
- C. When cutting and patching of the structure is made necessary due to this Contractor's failure to install piping, sleeves or equipment on schedule, or due to this Contractor's failure to furnish, on schedule, the information required for the leaving of openings, it shall be this Contractor's responsibility to make arrangements for this cutting and patching. This Contractor shall pay any additional cost incurred in this respect.
- D. Provide cutting and patching and patch painting in the existing structure, as required for the installation of the work. Furnish lintels and supports as required for openings. Cutting of structural support members will not be permitted without prior approval of the Architect/Engineer. Extent of cutting shall be minimized. Use core drills, power saws or other machines which will provide neat, minimum openings. Patching shall match adjacent materials and textures and shall be performed by craftsmen skilled in the respective craft required.
- E. Underfloor Plumbing Work:
 - 1. Contractor shall coordinate all related activity with General Contractor at least 24 hours before beginning construction activity.

2. Contractor, before saw-cutting floor, must first field verify all existing piping service, sizes, locations, depths, flow directions as well as coordinate with any other trades who may have utilities such as wires or conduits concealed beneath floor and which may be subject to damage and subsequent service interruptions. The cost to repair any damaged utilities shall be borne by The Contractor.
3. Contractor shall be responsible for erecting and maintaining suitable temporary construction barriers and enclosures for containment of all construction dust and debris. Enclosures and barriers shall be maintained under negative pressure and fans and filters as needed to assist with containment.

2.3 EXCAVATION AND BACKFILL

- A. Contractor shall coordinate all related activity with General Contractor at least 24 hours before beginning construction activity.
- B. The Contractor shall be responsible for erecting and monitoring of all safety barricades and related protection around excavation and work areas.
- C. Trenches and excavations may be backfilled by the Contractor only after required testing has been satisfactorily performed and locations of connections and appurtenances which will be concealed have been recorded by the Contractor in the construction record documents.
- D. Bedding:
 1. Gravity Storm Sewer or Sanitary Sewer Pipe Bedding Material:
 - a. Rigid Pipe:
 - 1) Rigid gravity storm or sanitary sewer pipe shall be provided with compacted granular bedding having a minimum thickness of 4" (100 mm) or 1/8th of the outside pipe diameter, whichever is greater.
 - 2) Clean gravel or crushed rock shall meet the following gradation for rigid sewer pipe. (RCP, DIP, VCP):
 - b. Non-Rigid Pipe:
 - 1) Non-rigid gravity storm or sanitary sewer pipe shall be provided with compacted granular bedding having a minimum thickness of 4" (100 mm) or 1/4th of the outside pipe diameter, whichever is greater.
 - 2) Gravel or crushed rock shall meet the following gradation for non-rigid sewer pipe: 100% passing a ¾" (19 mm) sieve, 50-80% passing a No. 4 (4.75 mm) sieve, and 25-60% passing a No. 8 (2.36 mm) sieve. (IADOT Gradation No. 10).
 2. Water mains or sanitary sewer force mains may be installed with undisturbed or compacted soil bedding provided the subgrade is consistent and the Contractor provides hand excavation for bells such that the pipe barrel bears evenly on the subgrade.
 3. Contractor shall be responsible for prompt cleanup and disposal of all unsuitable or excess bedding materials.
- E. Backfill:
 1. Suitable excavated material: Free of cinders, ashes, refuse, rocks, pavement fragments, vegetative or organic matter. Unless noted otherwise on the plans, sand shall not be used.

2. Granular backfill shall be crushed limestone or gravel with 100% passing a $\frac{3}{4}$ " (19 mm) sieve, 50-80% passing a No. 4 (4.75 mm) sieve, and 25-60% passing a No. 8 (2.36 mm) sieve. (IADOT Gradation No. 10)
3. Place backfill simultaneously on both sides of pipe to prevent displacement and place at an angle so that impact on installed pipe is minimized.
4. Backfill in the pipe envelope (top of bedding to a point 12" (300 mm) above the pipe) shall be hand placed. Material shall be of even consistency and free of clumps and boulders, finely divided, and shall be compacted to 90% maximum Standard Proctor Density. Material within the pipe envelope shall be the same as specified for trench backfill, unless noted otherwise on the Plans
5. Contractor shall be responsible for prompt cleanup and disposal of all unsuitable or excess backfill materials.

2.4 CONCRETE AND MASONRY WORK

- A. Concrete work included herein or shown on the drawings shall be in conformance with Division 3 - Concrete.
- B. Concrete work included herein or shown on the drawings shall be done only by experienced cement finishers. Brickwork, where included, shall be laid only by experienced brick masons. Brick shall be of uniform size, hard burned, and shall be laid in cement mortar, except for patch work at a location where cement and lime mortar has previously been used. Exposed, finish brickwork shall match existing brickwork as closely as practical and shall be to the satisfaction of the Architect/Engineer and Owner.
- C. Concrete bases and pads for mechanical equipment will be furnished by General Contractor. This Contractor shall coordinate size and location.
- D. Concrete bases and pads for mechanical equipment shall be furnished by this Contractor. Size bases to extend minimum of 4" beyond equipment base in any direction, and 4" above finished floor elevation. Construct of reinforced concrete, roughen floor slab beneath base for bond, and provide steel rod anchors between floor and base. Locate anchor bolts using equipment manufacturer's templates. Chamfer top and edge corners.
- E. Locate, furnish and install all support, hanger and equipment anchor bolts and related hardware.
- F. Underfloor Plumbing Work:
 1. Contractor shall coordinate all related activity with General Contractor at least 24 hours before beginning construction activity.
 2. Contractor shall saw cut, remove and properly dispose of concrete and related debris as required to accommodate new underfloor piping and fixtures.
 3. Patch floor to match adjacent floor textures and reinforce with #3 rebar, 18" O.C. (drill and grout 3" imbed).
 4. Unless noted otherwise, concrete shall be commercial grade with a minimum 28-day compressive strength of 5,000 PSI. Do not allow air content of troweled finished floors to exceed 3%

2.5 ROOF OPENINGS

- A. Roof openings required by this Contractor that are not shown on the Structural or Architectural Drawings shall be cut and adequately reinforced by an experienced roofing contractor.

- B. Roof penetrations for piping shall be through curbed roof openings. Equipment supports shall be by curbed and flashed runners meeting current National Roofing Contractor Association (NRCA) standards and details. Pitch pockets, pitch pans, and wood blocking are not acceptable.
- C. All roof work shall be completed such that it does not void any existing roof warranty.

2.6 CLEANING

- A. Keep the premises clean of all dirt and debris, caused by the work in accordance with Division 1 - General Requirements.
- B. Keep the premises clean of all debris caused by the work at all times, and keep materials stored, in areas designated by the Owner, in such a manner as not to interfere with the progress of the work of other Contractors or with the operation of existing facilities.
- C. At the conclusion of the construction, the site shall be thoroughly cleaned of all rubble, debris and unused material and shall be left in good order. Closed off spaces shall be cleaned of waste such as material, cartons, and wood frame members used in the construction.

2.7 WIRING FOR PLUMBING EQUIPMENT

- A. The Division 26 Contractor shall provide power including connection to all electrically powered equipment furnished by the Division 22 Contractor. Where electrical disconnect switches are not explicitly specified to be furnished as part of Division 22 equipment, the Electrical Contractor shall furnish suitable type(s) and properly rated electrical disconnect switches for all said mechanical equipment.
- B. Provide integral wiring, alarm wiring, control wiring, temperature control wiring and interlock wiring for equipment furnished, whether or not such wiring is furnished by the equipment vendor.
- C. Except as noted otherwise or where other sections call for motor starters to be furnished by manufacturers as part of their equipment, the Division 26 Electrical Contractor shall furnish motor starters as required for motors furnished by this Division 22 Contractor.
- D. Furnish shop drawings including but not limited to detailed schedules and wiring diagrams to other interested trades including Division 26 electrical contractor for all electrically powered equipment furnished. Schedules shall include: electrical loads and characteristics, max. overcurrent fuse protection / circuit breaker needs, disconnect requirements, motor starter requirements and motor horsepower(s). Include drawings as needed to depict locations of electrical and control panels, service clearances, disconnects as well as wiring connection points.
- E. The Division 22 Contractor shall be responsible to pay for all additional costs incurred due to equipment substitutions by Division 22 Contractor, which require either larger electrical service or service of a different electrical characteristic than scheduled on the Drawings.
- F. Prior to bid submission, this Division 22 Contractor shall review the Electrical Drawings and promptly bring to the attention of the Architect/Engineer, any omissions or errors in the electrical services required for equipment proposed to be furnished.

2.8 PROTECTION

- A. Special steps shall be taken as necessary for the protection of equipment and materials furnished under Division 22. Equipment and materials shall be protected by Contractor from any physical damage due to weather elements, dirt, dents, sheet rock installation, and painting until the project is completed. Damage, if incurred, shall be promptly repaired at no additional cost to Owner, as-needed to restore equipment and materials to original as-new condition.
- B. Protection of equipment during the finishing (sheet rock, plastering and painting) of the building interior shall be the responsibility of the contractor or contractors performing that work. This shall not relieve this Division 22 Contractor of the ultimate responsibility of checking and ensuring that adequate protection is provided and maintained at all times.
- C. Where the installation or connection of equipment requires Division 22 Contractor to work in areas previously finished by other Contractors, the Division 22 Contractor shall be responsible to ensure that such finished areas are adequately protected and are not marred, soiled or otherwise damaged during the course of their said work. If damage occurs this Division 22 Contractor shall be responsible to arrange for the other Contractors to repair and refinish any damaged areas and shall pay for all repair, rework and refinishing required.
- D. When heavy materials must be placed upon or transported over the roof deck, sheeting shall be placed to distribute the weight and support such materials. Any damage shall be immediately corrected at no cost to the Owner.

2.9 NOISE AND VIBRATION

- A. Contractor shall install all equipment in a such a manner so as to control the transmission of noise and vibration from any installed equipment, components or systems, so the sound level in any occupied area does not exceed NC-35 levels. Contractor shall correct all objectionable noise levels in any occupied areas and at no additional cost to Owner, which are due to improperly installed or isolated equipment, components or systems.

2.10 TESTS AND DEMONSTRATIONS

- A. Systems shall be tested and placed in proper working order prior to demonstrating systems to the Owner.
- B. Prior to acceptance of the plumbing installation, demonstrate to the Owner or his designated representatives essential features and functions of all systems installed, and instruct the Owner in the proper operation and maintenance of such systems.
- C. Furnish the necessary trained personnel to perform the demonstrations and instructions and arrange to have the manufacturer's representatives for the system present to assist with the demonstrations. The Owner and Contractor shall each sign a certification stating that the training has been performed and the Owner accepts same.

2.11 UTILITY REBATE APPLICATIONS

- A. This contractor shall be responsible for gathering information necessary for completing local utility rebate applications and submitting to the proper utility companies for gas and electric rebates. Potential rebates include high efficiency gas boilers, thermostats, timeclocks, motors, and other items furnished by this plumbing contractor.

END OF SECTION

**SECTION 22 0519
METERS AND GAUGES FOR PLUMBING PIPING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide equipment, materials, labor, and supervision necessary to install thermometers and gauges.
- B. Thermometers
- C. Thermometer Wells
- D. Gauges

1.2 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; The American Society of Mechanical Engineers; 2013.
- B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014.
- C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2007.

1.3 QUALIFICATIONS

- A. Thermometers: Weiss, Weksler, Ashcroft, Reotemp, U.S. Gauge or Therice.
- B. Gauges: Weiss, Weksler, Ashcroft, McDaniel, U.S. Gauge or Therice.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product and installation data. Provide list that indicates use, operating range, total range and location for manufactured components.

PART 2 PRODUCTS

2.1 THERMOMETERS

- A. Stem Type:
 - 1. 9 in. "Adjust-Angle" industrial thermometer, complete with double thick glass front, non-toxic blue ribbon liquid, separable socket and arranged so the unit can be set at any required angle front to back or left to right during or after installation. Range 32 F - 240 F for hot water, 50 F - 400 F for steam, and 0 F - 100 F for chilled or domestic cold water.
- B. Dial Type:
 - 1. 4-inch diameter, all stainless steel hermetically sealed per ASME B40.3, stainless steel stem, head and bezel. Coordinate stem length with system served. Bi-metal coil sensor, aluminum dial with black markings, glass lens, 1% full scale accuracy. Range 20 deg F - 240 deg F for hot water, 0 deg F - 100 deg F for domestic cold water.

2.2 GAUGES

- A. 4 in. compound pressure vacuum gauge, liquid filled, aluminum, steel or stainless steel case, white dial, 1/4-in. male NPT. Range 30 in. vacuum to 100 pound pressure for water, 30 in. vacuum to 30 pound pressure for low pressure steam, 30 in. vacuum to 1-1/2 times system pressure for medium and high pressure steam. Provide siphon (pigtail) for steam gauges. Provide level handle union cock for steam and water gauges.

2.3 THERMOMETER WELLS

- A. Provide thermometer wells constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 2" extension for insulated piping. Provide cap nut with chain fastened permanently to thermometer well.
- B. Manufacturer: Same as thermometers.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install thermometers in discharge and hot water recirculation return piping at water heaters, and at other points as shown on the Drawings.
- B. Install gauge for each pump, mounted on 1/4 in. stainless steel pipe manifold connected to the suction and discharge of the pump, with lever handle union cocks in the manifold on each side of the gauge, so that the gauge may be opened to either the suction or discharge pressure.
- C. Install gauges at pressure reducing valves and at other points as shown on the Drawings.

END OF SECTION 22 0519

**SECTION 22 0523
GENERAL DUTY VALVES FOR PLUMBING PIPING**

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Provide equipment, materials, labor, and supervision necessary to install valves as indicated on drawings and in schedules and herein specified.
- B. As nearly as possible, all valves shall be of a single manufacturer.
- C. Valves shall conform to ANSI standard dimensions.
- D. ASME Compliance:
 - 1. ASME B16.10 for ferrous valve dimensions.
 - 2. ASME B31.9 for building services piping valves.
- E. NSF Compliance: NSF/ANSI 61 and/or NSF/ANSI 372 for valve materials for potable-water service. Valves for domestic water must be 3rd Party Certified.

1.2 SUBMITTALS

- A. Submit detailed Shop Drawings and Product Data clearly indicating manufacturer, model, size, dimensions and pressure rating.
- B. For records documentation submit valve schedule, indicating valve ID, type, size and intended service and location.

1.3 PACKAGING

- A. Valves shall be furnished or provided with protective packaging to prevent damage during shipping or on the job site.
- B. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set ball valves open to minimize exposure of functional surfaces.
 - 4. Block check valves in either closed or open position.
- C. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- D. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

1.4 DEFINITIONS

CWP: Cold working pressure.

EPDM: Ethylene propylene copolymer rubber.

NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

PTFE: Polytetrafluoroethylene plastic.

SSP - Saturated Steam Pressure

WP - Working Pressure

SWP - Steam Working Pressure

W.O.G. - Water, Oil, Gas Pressure

BR - Bronze

I.B.B.M. - Iron Body, Bronze-Mounted

O.S.&Y. - Outside Screw and Yoke

N.R.S. - Non-Rising Stem

R.S. - Rising Stem

M.S.S. - Manufacturer's Standardization Society of the Valve and Fitting Industry, Inc.

Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content =0.25% per Safe Drinking Water Act as amended January 4, 2011, Section 1417.

PART 2 PRODUCTS

2.1 GENERAL

- A. Materials: Discs, gaskets, packings, seats, diaphragms and lubricants shall conform to recommendations of the valve manufacturer for the intended use.
- B. Body materials, unless otherwise stated:
 - 1. Bronze: 125-150 lbs., ASTM B62
 - 2. High Grade Steam-Metal or Valve-Bronze Alloy: 200-300 lbs., ASTM B61
 - 3. Cast Iron: ASTM A126, Class B
 - 4. Ductile Iron: ASTM A395, A536
 - 5. Cast Steel: ASTM A216
- C. Lead Free silicon bronze (ASTM listed) valves shall be made with corrosion-resistant materials. Manufacturer shall provide third party certification tested in accordance with EN ISO 6509 regarding dezincification corrosion resistance and stress corrosion cracking.
- D. Bronze Valves: NPS 2 (DN 50) and smaller with threaded or solder ends, unless otherwise indicated.
- E. Ferrous Valves: NPS 2-1/2 (DN 65) and larger with flanged ends, unless otherwise indicated.
- F. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- G. Valve Sizes: Same as upstream piping unless otherwise indicated.
- H. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Grooved: With grooves according to AWAA C606.

3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.
5. Copper Press: With sockets according to ASME B16.22/ASTM B75.
- I. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 1. Ball Valves: With extended operating handle of non-thermal-conductive material that meets UL 2043 approved for inside air plenum, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied.
 2. Gate Valves: With rising stem.

2.2 MANUFACTURERS

- A. Subject to compliance with requirements, provide products manufactured by one of the following, as listed for each valve type, or Engineer-approved equivalent.

Valve Type	Approved Manufacturer
Gate and Check Valves	Crane, Stockham, Lunkenheimer, Hammond Industrial Series, NIBCO, Milwaukee
Ball Valves	Jamesbury, Apollo, Jenkins, Milwaukee, Watts, Worchester, Powell, or NIBCO
Automatic Valves	ASCO, Skinner, Clayton, Parker

2.3 GATE VALVES

- A. Provide gate valves complying with MSS SP-70 or MSS SP-80. Gate valves shall be as follows unless otherwise indicated on the drawings.
1. 2 in. and Smaller: 125-lb. saturated steam, screwed, solid wedge disc, and all parts ASTM B62 grade bronze except wheel and packing.
 2. 2-1/2 in. through 16 in.: 125-lb. saturated steam, O.S.&Y., flanged ends, bronze seats and stem, double-seated solid wedge disc, iron body and bonnet.
- B. Equip valves with packing suitable for intended service.
- C. Provide gate valves designed such that back seating protects packing and stem threads from fluid when valve is fully opened. Equip valves with gland follower.
- D. Gate valves used for ASME Section IV vessel isolation valves shall have adjustable type packing gland.

2.4 CHECK VALVES

- A. Provide check valves complying with MSS SP-71 or MSS SP-80 for water, steam, and air shall be as follows unless otherwise shown on the drawings:
1. 3 in. and smaller: 200-lb. saturated steam, swing type, threaded, bronze body meeting ASTM B62, pressure tight removable disc, hinge bumper to prevent sticking open, can be mounted horizontally or vertically.

2.5 BALL VALVES

- A. Provide ball valves complying with MSS SP-72 or MSS SP-110. Ball valves shall be as follows unless otherwise indicated on the drawings.
1. 2 in. and smaller: ASTM B584 bronze body, 2-piece, full port stainless steel brass ball, screwed or soldered ends with teflon seats and seals, blow out proof stem, tee or lever handle rated to 150 SWP/600WOG.
 2. 2 in. and smaller for medical gas systems: ASTM B62 forged brass or bronze body, 3-piece, full port, stainless steel ball, soldered ends with Teflon seats and seals, lever handle.
 3. Over 2 in.: ASTM A2116 carbon semi-steel or ASTM A536 ductile iron body, 2-piece, full port stainless steel brass ball, ANSI rated flanged ends with teflon seats and lever handle rated to 150 SWP/600WOG.
- B. BRONZE BALL VALVES
1. Three-piece, full port, silicon bronze ball valves with the capability of accepting extended operating handles:
 - a. Description:
 - 1) Standard: MSS SP-110 and ASME A1124.14.
 - 2) CWP Rating: 600 psig.
 - 3) Body Design: Three piece bronze with threaded body packnut design (no threaded stem designs allowed) with adjustable stem packing.
 - 4) Body Material: Silicon bronze (ASTM Listed), corrosion resistant.
 - 5) Ends: Threaded or soldered.
 - 6) Seats: PTFE or TFE.
 - 7) Stem: Stainless steel (silicon bronze available).
 - 8) Ball: Stainless steel (silicon bronze available).
 - 9) Port: Full.
 2. Two piece, full port, silicon bronze ball valves with the capability of accepting extended operating handles.
 - a. Description:
 - 1) Standard: MSS SP-110 and ASME A1124.14.
 - 2) CWP Rating: 600 psig.
 - 3) Body Design: Two piece bronze with threaded body packnut design (no threaded stem designs allowed) with adjustable stem packing.
 - 4) Body Material: Silicon bronze (ASTM Listed), corrosion resistant.
 - 5) Ends: Threaded, soldered or pressed.
 - 6) Seats: reinforced PTFE or TFE.
 - 7) Stem: Stainless steel (silicon bronze available).
 - 8) Ball: Stainless steel (silicon bronze available).
 - 9) Port: Full.
- C. CPVC and PVC ball valves shall be union type, full port, schedule 80.

2.6 DRAIN VALVES (HOSE BIBBS)

- A. Soldered or Threaded Ends: Bronze body, screwed bonnet, rising stem, composition disc, 3/4 in. threaded hose outlet connection; 125 psi maximum pressure rating.

2.7 ACTUATORS, HANDWHEELS, OPERATORS, HANDLES

- A. Provide suitable handwheels for gate, globe and drain valves.
- B. Valve Actuator Types:
 - 1. Handwheel: For valves other than quarter-turn types.
 - 2. Hand lever: For quarter-turn valves NPS 6 (DN 150) and smaller.
- C. Provide one plug valve wrench for every 10 plug valves sized 2 in. and smaller, minimum of one. Provide each plug valve, sized over 2 in. with a wrench, with set screw.

PART 3 EXECUTION

3.1 VALVE LOCATIONS – GENERAL

- A. Unless otherwise noted, shutoff valves shall be provided at all equipment connections (supply and return where applicable) for the following piping: pump suction and discharge, water, air, fuel and gas and drain lines (except on gravity drains from pans). Equipment connections include such items as tanks, pumps, heat exchangers, and similar items.
- B. Check valves of the non-slam type shall be installed at the discharge of pumps unless otherwise shown on the drawings.
- C. Install isolation valves at each branch off of horizontal mains and vertical risers.
- D. Install chainwheels on operator for ball and gate valves NPS 4 (DN 100) and larger and more than 96 inches (2400 mm) above floor or more than three feet above ceiling. Extend chains to 60 inches (1520 mm) above finished floor or just above ceiling.

3.2 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent this movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.3 VALVE INSTALLATION

- A. Follow the manufacturer's recommended installation instructions concerning soldering, silver brazing, welding, threading, and installation of flanged valves in order to prevent damage to the valve and assure its maximum efficiency. Additional specific installation requirements are as follows:
 - 1. Thread pipe for threaded valves to standard length only, using new block dies.
 - 2. Put pipe compound on the pipe end, not into the valve threads. Securely screw pipe and valve together.
 - 3. Blow out or otherwise thoroughly clean pipe sections before they are installed.
 - 4. Close valve before installation.
 - 5. Secure and adjust valves for no leaks and for easy operation.
 - 6. Install valves with stems horizontal or vertical above the pipe and square with building construction. Install valves in position to allow full stem movement.
 - 7. Install valves so piping does not place a stress or strain on the valve body. Locate valves for easy access and provide separate support where necessary.
 - 8. Install extended-stem valves where insulation is indicated. Stems shall be extended such that the handle moves freely without contact with the insulation.
 - 9. Install drain valves at low points of piping, at each mechanical equipment item, and elsewhere, where indicated.
 - 10. Locate valves, cock, and hose bibbs to allow easy accessibility for operation, maintenance and repair.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Lift Check Valves: With stem upright and plumb.
- D. When soldering use paste fluxes that are approved by the manufacturer for use with Lead Free Alloys.

3.4 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.5 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball or Gate valves.
 - a. Piping NPS 2 (DN 50) and smaller: Furnish bronze ball or gate valves.
 - b. Piping NPS 2-1/2 (DN 65) and larger: Furnish cast-iron butterfly or gate valves with flanged ends.

2. Throttling - Balancing Service: Ball valves.
 - a. Piping NPS 2 (DN 50) and smaller: Furnish bronze ball or globe valves.
 - b. Piping NPS 2-1/2 (DN 65) and larger: Furnish cast-iron butterfly valves with flanged ends.
3. Hot-Water Piping, Balancing Duty: Memory-stop balancing valves.
4. Drain Duty: Hose-end drain valves.
5. Cast-iron, grooved-end valves may be used with grooved-end piping.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 1. Install hose-end drain valves at low points in water mains, risers, and branches.
 2. Install stop-and-waste drain valves where indicated.
- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 (DN 50) and smaller and butterfly valves for piping NPS 2-1/2 (DN 65) and larger. Balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."
- E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Calibrated balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."
- F. If valves with specified CWP ratings are not available, the same types of valves with CWP ratings may be substituted.
- G. Select valves, except wafer types, with the following end connections:
 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded, Sweat solder, or Press-to-fit ends.
 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Grooved Mechanical Coupling, Flanged, or Threaded ends .
 3. For Copper Tubing, NPS 5 (DN 125) and Larger: Grooved Mechanical Coupling or Flanged ends.

3.6 VALVE SCHEDULE

VALVE TYPE

SERVICE

GATE - ALL SIZES DOMESTIC COLD, HOT AND RECIRCULATING SYSTEMS; FOR
OPERATION UP TO 200 PSI AT 500 F. FOR APPLICATIONS WHERE BALL VALVES ARE
NOT SUITABLE.

CHECK - ALL SIZES WATER SYSTEMS.

BALL - ALL SIZES DOMESTIC COLD WATER, HOT, AND RECIRCULATING SYSTEMS; FOR
OPERATION UP TO 200 PSI AT 500 F.

DRAIN DOMESTIC WATER SYSTEMS

END OF SECTION 22 0523

**SECTION 22 0529
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide equipment, materials, labor and supervision necessary to install pipe hangers and supports.
- B. Pipe support systems shall secure pipes in place, prevent pipe vibration, provide vertical adjustment for maintaining required grades, and provide for expansion and contraction.
- C. Where supports are attached to concrete or other structural members, care shall be taken to prevent damage or weakening of the structural members.
- D. Where concrete inserts are to be used, it shall be this Contractor's responsibility to accurately locate and attach inserts to concrete forms.

1.2 REFERENCE STANDARDS

- A. American National Standards Institute, ANSI:
 - 1. ANSI B31.1 Power Piping
 - 2. ANSI B31.9 Building Services Piping
- B. Manufacturers Standardization Society of the Valve and Fittings Industry, MSS, 1815 North Fort Myer Drive, Arlington, VA 22209.
 - 1. MSS SP-58: Pipe Hangers and Supports - Materials, Design and Manufacturer.
 - 2. MSS SP-69: Pipe Hangers and Supports - Selection and Application.
- C. Anvil International, 2 Holland Way, Exeter, NH 03833, www.anvilintl.com, (603) 418-2800.
 - 1. Pipe Hangers and Supports Catalog (Jan. 2015)

1.3 DEFINITIONS

- A. Pipe Hanger: A device normally suspended from structure and is used to carry the piping weight in tension.
- B. Pipe Support: A device by which piping is normally carried from beneath and is used to carry the piping weight in compression.

1.4 SUBMITTALS

- A. Submit manufacturer's product data on all hangers and support devices. Product data to include, but not be limited to materials, finishes, approvals, load ratings, and dimensional information.

PART 2 PRODUCTS

2.1 HANGERS AND SUPPORTS

- A. Hangers and support devices shall be Anvil International Inc., Tolco, Fee and Mason, Michigan, B-Line or Engineer approved equivalent. Figure numbers within are based on Anvil International, Inc.

PART 3 EXECUTION

3.1 INSTALLATION - HORIZONTAL PIPE SUPPORTS

- A. Hanger rods for steel, wrought iron and brass pipe shall be installed in accordance with MSS SP-69 Tables 3 and 4 and the following schedule:

Pipe Size	Rod Diameter	Maximum Spacing
Up to 1 1/4"	3/8"	7'-0"
1 1/2" and 2"	3/8"	9'-0"
2"	3/8"	10'-0"
2 1/2", 3", and 3 1/2"	1/2"	10'-0"
4" and 5"	5/8"	12'-0"
6"	3/4"	12'-0"
8"	7/8"	14'-0"
10" and 12"	7/8"	16'-0"
14" and 16"	1"	16'-0"
18"	1 1/8"	18'-0"
20" and 24"	1 1/4"	20'-0"

- B. Hanger rods for copper pipe and tube shall be installed in accordance with MSS-SP-69 Tables 3 and 4 and the following schedule:

Pipe Size	Rod Diameter	Maximum Spacing
1/2" and 3/4"	3/8"	5'-0"
1"	3/8"	6'-0"
1 1/4"	3/8"	7'-0"
1 1/2"	3/8"	8'-0"
2"	3/8"	8'-0"
2 1/2"	1/2"	9'-0"
3", 3 1/2", and 4"	1/2"	10'-0"
5"	1/2"	13'-0"
6"	5/8"	14'-0"
8"	3/4"	16'-0"

- C. Support horizontal cast iron soil pipe with two hangers for each pipe length. Locate hangers close to couplings.
- D. In addition to the above specified spacings, install additional hangers at change in pipe direction and at concentrated loads, large valves and strainers.

- E. Where more than one pipe is to be run parallel together, they may be supported on trapeze type hangers. Trapeze bar angles and hanger rods shall be of sufficient size to support the particular group of pipes. Trapeze hanger spacing shall be based on the smallest pipe on the rack. When hanging from light gauge metal trusses, coordinate pipe hanger spacing and hanger rod connection points with the truss manufacturer.
- F. For suspending hanger rods from brackets attached to walls, use welded steel brackets: Fig. 194 for loads up to 750 lbs; Fig. 195 for loads up to 1500 lbs; Fig. 199 for loads up to 3000 lbs.
- G. Where pipes are to be racked along walls, use " Unistrut" pipe racks or 12 gauge steel strut channel, 1-5/8" x 1-5/8" minimum.
 - 1. Mount pipes to strut channel with two-piece pipe straps to match outside diameter of pipe including insulation.
- H. Attach all pipe hangers from support rods using double locknuts tightened to prevent loosening.

3.2 INSTALLATION - VERTICAL PIPE SUPPORTS

- A. Support vertical steel, wrought iron, copper and brass pipe at every other floor line.
- B. Support vertical cast iron soil pipe at every floor line.
- C. In addition to the above, support vertical pipes at base of riser with base fitting set on concrete or brick pier, or by hanger located on horizontal connection close to riser.
- D. Where pipe sleeves extend above floor, place pipe clamps at ceiling below and support clamp extensions from inserts or other approved attachment.

3.3 PIPE ATTACHMENTS

- A. For horizontal steel and wrought iron pipe, use carbon steel adjustable clevis hanger, Fig. 260. For floor support or support directly above steel beams, use adjustable pipe roll stand, Fig. 177.
- B. For horizontal copper pipe and tube, use copper-plated, carbon steel adjustable swivel ring, Fig. CT-69.
- C. When thermal expansion for horizontal pipe is in excess of 1/2" axially, use adjustable steel yoke pipe roll, Fig. 181, or adjustable pipe roll stand, Fig. 177.
- D. For horizontal cast iron soil pipe, use carbon steel adjustable clevis hanger, Fig. 260.
- E. For vertical steel, wrought iron and cast iron pipe, use extension pipe or riser clamps, Fig. 261.
- F. For vertical copper pipe and tube, use copper-plated, copper plated copper tubing riser pipe clamp, Fig. CT-121.

3.4 INTERMEDIATE ATTACHMENTS

- A. Hanger rods: Carbon steel single or double end threaded, Figs. 140, 253 as required. Continuous threaded rod, Fig. 146 may be used wherever possible.
- B. Chain wire or perforated strap hangers will not be permitted. One pipe shall not be suspended from another pipe.

3.5 STRUCTURAL ATTACHMENTS

- A. For attaching steel or copper plated hanger rods to reinforced concrete, use galvanized malleable iron universal concrete inserts; Fig. 282 for loads up to 1140 lbs.
- B. For attaching steel hanger rods to structural steel beams, use malleable iron C-clamps; Fig. 92, Fig. 93 or Fig. 94 with retaining clip Fig. 89 or Fig. 89X for loads up to 500 lbs; Fig. 218 with extension piece for loads up to 1,365 lbs. For copper plated hanger rods, use copper plated malleable iron C-clamps; Fig. CT-138R for loads up to 180 lbs.
- C. For attaching steel hanger rods to wood structural members, use malleable iron ceiling flange; Fig. 153 for loads up to 1,270 lbs. For copper plated hanger rods, use copper plated malleable iron ceiling flange; Fig. CT-128R for loads up to 180 lbs.
- D. Vertical expansion shields or toggles shall not be used for suspending hanger rods, except with permission in cases where inserts have been omitted or cannot be used. If permitted, use expansion shields; for rod sizes up to ½", 320 lbs. max. load. For hanger rods larger than ½" use attachment plate, Fig. 52, with wedge anchors.
- E. Powder actuated anchoring methods shall not be used.

3.6 PIPE COVERING PROTECTION

- A. Hangers and supports for insulated piping shall not injure or pierce insulation. Provide insulation protection shields in conjunction with hanger or roll device. Use Fig. 160 and 165, Protection Saddles.

3.7 SUPPLEMENTAL STEEL

- A. Provide supplemental steel as required to hang or support plumbing equipment or piping.

END OF SECTION 22 0529

**SECTION 22 0553
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide materials, equipment labor and supervision necessary to install piping identification products.
- B. Comply with ANSI A13.1 for lettering size, length or color field, colors, and installed viewing angles of identification devices.

1.2 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers; 2007.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2013.

1.3 SUBMITTALS

- A. Submit manufacturer's product data.
- B. Submit sample of each type of identification product and clearly identify the contents in a schedule.
- C. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- D. Schedule:
 - 1. Submit valve schedule for each system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve ID tag number, system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves that are intended for emergency shut-off and similar special uses, by special "flags" in margin of schedule.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Brady Corp., Industrial Safety Supply, Emedco, Seton or Brimar.
- B. Engineer approved alternative

2.2 PIPE MARKERS

- A. Provide manufacturer's standard preprinted, semi-rigid snap-on or self-sticking, color-coded pipe markers, complying with ANSI A13.1.
- B. Provide full-band pipe markers, extending 360° around pipe at each location or self-sticking pipe markers, fastened in the following method:
 - 1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
 - 2. Secure to piping and install banding tape on both ends of each pipe label.

- C. Lettering shall be manufacturer's pre-printed nomenclature which best describes piping system in each instance, as selected by Architect/Engineer in cases of variance.
- D. Print each pipe marker with arrows indicating direction of flow, integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic or on banding tape.

2.3 EQUIPMENT MARKERS

- A. Provide engraved signage nameplates and tags constructed of multi-layered acrylic that has been treated for outdoor use and can withstand temperatures up to 160° F. Nameplates shall have beveled edges with contrasting color core, letters, and border. Minimum size of nameplate shall be 3" high by 6" long. The minimum letter height shall be 3/4". Attachment shall be by double faced 2 mil permanent acrylic adhesive. For equipment that doesn't allow for direct attachment, furnish sheet metal backing to integrate with equipment such that signage can be read from 5 feet above the finished floor. Unless noted otherwise, signage shall be provided with black lettering, black border, and yellow core. All signage shall include up to 14 characters per line, minimum of 3 lines per tag. Furnish signage for equipment shown in Section 3:
 - 1. All pumps shall include the full name description for system served such as *"Primary Chilled Water Pump – 1."*
- B. All equipment shall be named consistent with the plans and specifications as indicated on the schedules or as directed by the Owner.

2.4 BRASS VALVE TAGS

- A. Provide manufacturer's standard brass valve tags with stamped black filled lettering, with piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 3/16" hole for fastener.
- B. Provide 1-1/2" round brass tags with black lettering. Seton 250 BL or equal.

2.5 VALVE TAG FASTENERS

- A. Manufacturer's standard solid brass chain or solid brass S-hooks of sizes required for proper attachment of tags to valves and manufactured specifically for that purpose.

2.6 VALVE SCHEDULE FRAMES

- A. For each page of schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSD-grade sheet glass.

2.7 PIPING AND EQUIPMENT IDENTIFICATION

- A. Piping systems that shall be identified by their controls (including directional arrows) on this project shall include, but are not necessarily limited to the following:
 - 1. Domestic cold water, hot water, and hot water recirculation.
 - 2. Sanitary and sanitary vent.

- B. Provide name plates for all equipment scheduled on the drawings. Coordinate nameplate tag with Owner's sequencing system. If the Owner has no preference, the nameplates shall correspond with the equipment schedule. Equipment shall include but is not limited to the following:
 - 1. Pumps.
 - 2. Expansion tanks.
 - 3. Water heaters.

PART 3 EXECUTION

3.1 INSTALLATION OF MECHANICAL IDENTIFICATION

- A. Where identification is to be applied to surfaces that require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.
- B. Install pipe markers on each system and include arrows to show normal direction of flow.
- C. Locate pipe markers as follows: wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) above lay-in type ceilings and exterior non-concealed locations.
 - 1. Near each valve and control device.
 - 2. Near each branch, excluding short take-offs for fixtures, mark each pipe at branch where there could be question of flow pattern.
 - 3. Near locations where pipes pass through walls or floors/ceilings, (both sides) or center non-accessible enclosures.
 - 4. Near major equipment items and other points of origination and termination.
 - 5. At each pipe passage to underground.
 - 6. Spaced intermediately at maximum spacing of 50 feet along each piping run, except reduce spacing to 25 feet in congested areas of piping and equipment.
 - 7. Where self-sticking labels are used, the pipe or its covering surface shall be properly prepared. This consists of removal of loose dirt, oil and grease, loose paint or peeling insulation covering. This can be done with a brush and cloth; washing is not required. Use solvent for removal of oil or grease.
 - 8. Banding tape must be used on both ends of all self-sticking labels. The tape shall encircle the pipe completely and overlap itself so the banding tape can adhere to itself.
- D. Provide valve tags for all major valves 1/2" size or larger. Included are all main, zone and branch valves, valves in all equipment rooms, etc. All types of valves, ball, globe, butterfly, cocks, control, regulating, relief, reducing, solenoid, etc. are to be identified except check valves. Do not identify end use point valves for plumbing fixtures, and similar rough-in connections.
- E. List each tagged valve in schedule for each system showing function and location. Provide separate charts for mechanical divisions of work. Charts shall be installed on a conspicuous wall in the main mechanical equipment room. Provide unframed copies of valve lists as part of closeout documents.

3.2 ADJUSTING AND CLEANING

- A. Relocate any mechanical identification device which has become visually blocked by work of this division or by other divisions.
- B. Clean face of identification devices and glass frames of valve schedules.

END OF SECTION 22 0553

**SECTION 22 0700
PLUMBING INSULATION**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide equipment, materials, labor and supervision necessary to install insulation to hot and cold surfaces of piping, tanks, ductwork, fittings and other surfaces.
- B. Insulation shall include insulating materials, jackets, adhesive, mastic coatings, tie wire and other materials as required to complete the insulating work.

1.2 CODES AND STANDARDS

- A. Insulating materials, jackets and mastics shall meet flame spread, fuel contribution and smoke developed ratings in accordance with NFPA-90A. Flame spread rating in accordance with NFPA 255, ASTM E-84, or UL 723 of not more than 25; smoke developed rating of not more than 50, unless otherwise noted in this section.
- B. Insulation that has been treated with a flame-retardant additive to meet the flame spread and smoke developed ratings shown above is not permitted.
- C. Insulation materials shall be non-corrosive to the materials they are applied to, including stress corrosion cracking of stainless steel and shall not breed or promote mold, fungus or bacteria.
- D. Insulation shall meet or exceed all requirements of ASHRAE/IES 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

1.3 QUALIFICATION

- A. Insulating materials by Owens-Corning, Armacell, Pittsburgh-Corning, Knauf, Johns Manville, or Engineer approved equivalent.
- B. Mastics and adhesives as recommended by insulation manufacturer.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation and jacket. Submit schedule showing manufacturer's product number, flame spread and smoke development rating, k-value, density, temperature limitations, sound absorption coefficients, thickness, and furnished accessories for each mechanical system requiring insulation.

PART 2 PRODUCTS

2.1 INSULATION

- A. Description:
 - 1. Type A: Preformed, sectional, heavy density fiberglass insulation, suitable for operating temperatures from - 20 F to +850 F. Equipped with factory-applied, all-service vapor barrier jacket constructed of white Kraft paper bonded to aluminum foil reinforced with fiberglass yarn, with pressure-sensitive, self-sealing longitudinal laps and butt strips. Thermal conductivity of 0.23 BTU-in/hr-ft²- F @ 75 F mean temperature. Water vapor permeance of 0.02 perms. Johns Manville "Micro-Lok HP or Engineer approved equivalent.

2. Type B: Flexible, elastomeric pipe and sheet insulation with closed-cell structure. Shall comply with ASTM C534, Type I, Grade 1 for tubular materials and ASTM C534 Type II, Grade 1 for sheet materials. Suitable for operating temperatures from -40° F to 220° F. Outdoor applications, and where otherwise noted, shall receive a weather-resistant, protective, latex enamel finish. Thermal conductivity of 0.28 BTU-in/hr-ft²-°F @ 75° F mean temperature. Water vapor permeance of 0.08 perms. Insulation shall be equivalent to Armacell AP Armaflex; adhesive equivalent to Armacell Armaflex 520 or Armaflex 520 BLV Low-VOC Contact Adhesive; finish equivalent to Armacell Armaflex WB finish.
3. Type C: Flexible, elastomeric thermal insulation with an expanded, closed-cell structure. Pre-slit tubular form with a pressure-sensitive adhesive strip for closure and vapor sealing of the longitudinal joint. Butt joints, sealed with 3M-471 tape. White color. Suitable for operating temperature of 40° F to 200° F. Thermal conductivity of 0.28 BTU-in/hr-ft²-°F mean temperature. Water vapor permeance of 0.20 perms. Insulation shall be Armacell Self-Seal Armaflex 2000 or Engineer approved equivalent.

2.2 PIPE INSULATION SCHEDULE

<u>SERVICE</u>	<u>TYPE</u>	<u>THICKNESS</u>	<u>PIPE SIZES</u>
DOMESTIC COLD	A, B, C	1/2"	>1-1/2"
		1"	=< 1-1/2"
DOMESTIC HOT WATER & HW CIRC.	A, B, C	1"	> 1-1/2"
		1 1/2"	=< 1-1/2"

2.3 EQUIPMENT INSULATION SCHEDULE (ASHRAE 90.1)

<u>SERVICE</u>	<u>TYPE</u>	<u>THICKNESS</u>
PIPE ANCHORS / GUIDES	B	3/4"

2.4 INSULATION JACKETS

- A. 20-mil high impact PVC secured with spray contact adhesive. All PVC jacketing shall meet the 25/50 SDR. Manville "Zeston 2000" or equivalent.
- B. 6-oz/sq yd UL listed cotton canvas fabric secured with Childers CP50 lagging adhesive.
- C. Fitting and valve jackets shall be premolded PVC with joints and seams sealed with a spray contact adhesive or vapor barrier mastic. Premolded jackets shall be Manville "Zeston 2000" or approved equivalent.
- D. At wall penetrations and on exterior pipe, provide an additional jacket of 0.020 inch thick smooth finish aluminum secured with 0.015 inch thick, 3/8-inch wide aluminum bands. Metal jacket shall have factory applied moisture barrier. Fitting and valve covers to be preformed of same material as adjacent metal jacket.
- E. Where PVC or metal jackets are used, delete the factory applied ASJ on pipe and equipment operating above 75° F.
- F. PVC jackets shall be used in the following areas and systems:
 1. Whenever piping is routed exposed through occupied spaces.
 2. Premolded PVC at all fittings and valve jackets.

PART 3 EXECUTION

3.1 GENERAL

- A. Use only experienced applicators regularly engaged in the trade. Rough work will be rejected. Application details shall be in accordance with the insulation materials supplier's recommendations, except where a higher standard is specified.
- B. Install materials after systems have been tested and approved. Material such as rust, scale, dirt and moisture shall be removed from surfaces to be insulated.
- C. Insulation shall be kept clean and dry at all times.
- D. Where pipes and ducts pass through fire rated walls, floors and partitions, a fire seal shall be provided.
- E. When flexible cellular insulation is used, it shall be installed with seams and joints sealed with contact adhesive.
 - 1. Wherever possible, the insulation shall be placed over the pipe before it is installed. Seal the butt joints with Armacell Armaflex 520, or Armaflex 520 BLV Low-VOC Contact Adhesive or equal.
 - 2. Where the insulation cannot be slipped on, cut the insulation longitudinally and apply it to the piping. Seal longitudinal seam and butt joints with Armacell Armaflex 520 adhesive, or Armaflex 520 BLV Low-VOC Contact Adhesive or equal. In all cases, the insulation, equal to Armacell AP, protected with half-round PVC sleeves the length of three times the nominal pipe size, minimum length to be 8 inches.

3.2 PIPE INSULATION INSTALLATION

- A. Insulate fittings, valves, unions, flanges, strainers, flexible connections and expansion joints with premolded or mitered segments of same insulating material as for adjacent pipe covering.
- B. Pipe insulation shall continue through sleeves and hangers with vapor barrier and/or jacket.
- C. Insert to be between support shield and piping but under the finish jacket. Provide an insert at hangers not less than 6 inches long, of same thickness and contour as adjoining insulation, to prevent insulation from sagging at support points. Inserts shall be heavy density insulating material suitable for the planned temperature range. Factory fabricated inserts may be used.
- D. Neatly finish insulation at supports, protrusions and interruptions.
 - 1. On hot systems where fittings are to be left exposed, insulation ends shall be beveled away from bolts for easy access.
 - 2. On cold systems, valve stems shall be sealed with caulking which allows free movement of the stem but provides a seal against moisture incursion.
- E. Wherever piping penetrates a floor or is exposed in a finished area such as kitchens, furnish a floor pipe escutcheon and/or PVC (white) jacket to protect insulation and allow for a smooth finish for cleaning.

3.3 EQUIPMENT INSULATION INSTALLATION

- A. Do not insulate factory-insulated equipment.
- B. Apply insulation as close as possible to equipment by grooving, scoring and beveling insulation, if necessary. Secure insulation to equipment with studs, pins, clips, adhesive, wires or bands.

- C. Fill joints, cracks, seams and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- D. Cover insulation with metal mesh and finish with ¼" coat of insulating cement applied in two 1/8" layers, if non-faced insulation is used.
- E. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.
- F. When equipment with insulation requires periodical opening for maintenance, repair or cleaning such as at manway covers or strainer plugs, install insulation in such a manner that it can be easily removed and replaced without damage. Removable insulation shall have a vapor-proof cover fabricated so as to allow it to be resealed to the equipment vapor barrier.
- G. Joints shall be sealed with 2" wide vapor barrier tape or strips to match insulation jacket, using a fire-resistive adhesive.

END OF SECTION 22 0700

**SECTION 22 1116
DOMESTIC WATER PIPING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide equipment, materials, tools, labor, and supervision necessary to furnish, fabricate, and install complete piping system.

1.2 CODES AND STANDARDS

- A. Pipe materials specified in this Section shall apply to technical sections of Division 22 of the Project Manual where applicable. Special requirements as may be called for in the technical sections, or shown on the Drawings, shall take precedence over General Requirements herein.
- B. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content =0.25% per Safe Drinking Water Act as amended January 4, 2011, Section 1417.
- C. NSF Compliance: NSF/ANSI 61 and/or NSF/ANSI 372 for valve materials for potable-water service. Valves for domestic water must be 3rd Party Certified.

1.3 PRODUCT HANDLING

- A. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage, and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.
- B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.
- C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1.4 SUBMITTALS

- A. For each system served: Submit piping schedule listing, by range of sizes, piping material used.
- B. Submit manufacturer's specifications and/or catalog data including material and pressure test certifications for pipe, fittings, valves, and other related items including but not limited to pipe hangers and supports.
- C. Locations of connections to existing water lines, service lines, valves, and water main appurtenances shall be submitted as a dimensioned drawing Owner's Representative or Architect/Engineer for construction record purposes.

PART 2 PRODUCTS

2.1 MATERIAL

A. Piping:

<u>MATERIAL</u>	<u>SERVICE</u>

Ductile iron water pipe, standard Underground water service main 3" dia. mechanical joint. ASTM A 536. ANSI A21.5 and larger. AWWA C151

Copper water tube, hard temper ASTM B88:

Type K Domestic water piping lines under building, concealed in solid concrete or masonry walls or construction; underground water service up to 3" dia.

Type L Aboveground domestic water piping lines.

PVC pipe, Schedule 80, ASTM D1785 Belowground domestic water piping lines.

B. Fittings:

1. Cast iron water pipe - Class 250, ANSI A21.20, AWWA C110, standard mechanical joint fitting with lugs for connecting to pipe.
2. Threaded pipe - ASME B16.3 malleable iron fittings, 125-pound, standard flat band water pattern.
3. Copper water tube, cast bronze or wrought copper, solder joint type. ANSI B16.18 and B16.22.
4. PVC pipe - Schedule 80 fittings, socket-type, ASTM D2466.

2.2 JOINTS

- A. Threaded pipe - make joints using approved pipe joint compound, applied to male threads only. Cut pipe square, cut threads clean, remove burrs, and ream ends to full size of bore. Threads shall not be exposed on chromium-plated pipe.
- B. Welded pipe - welding shall conform to welding sections of ASME B31.1 "Code for Power Piping". Pipe up to 2" diameter shall be threaded and coupled and Pipe 2-1/2" diameter or larger shall be welded.
- C. Copper water and drainage tube - use 95-5 tin antimony or silver solder, cut pipe square, clean and polish tube ends and inner surface of fittings, apply flux and solder joint as recommended by manufacturer of solder type fittings. Use same methods for copper refrigerant pipe, except use silver solder with 15% silver content, equivalent to Sil-Flos 15.
- D. Solid wall schedule 80 PVC DWV - solvent cemented joints per ASTM D2466.
- E. When soldering use paste fluxes that are approved by the manufacturer for use with Lead Free Alloys.

2.3 NIPPLES AND UNIONS

- A. Nipples shall conform to size, weight, and strength of adjoining pipe. When length of unthreaded portion of nipple is less than 1-1/2", use extra strong nipple; do not use close nipples.

- B. For pipe 3" and smaller, use screwed unions; over 3", use flanged unions. For steel and wrought iron pipe, use malleable iron ground joint unions, black or galvanized, to conform to pipe. Cast iron flanged unions are to be gasket type. For threaded brass pipe, use bronze ground joint unions with octagon ends. Install unions on equipment intended to be disassembled.
- C. Dielectric unions shall be installed between connections of copper pipe and ferrous piping.

2.4 SLEEVES

- A. Floor sleeves shall be provided by the contractor. Coordinate with existing structure and notify engineer if structure interferes with design.
- B. Sleeves passing through non-load bearing walls and partitions shall be galvanized sheet steel with lock seam joints of minimum gauges as follows: For pipes 2-1/2" in size and smaller - 24-gauge; 3 in. to 6 in. - 22-gauge; over 6 in. - 20-gauge.
- C. Sleeves passing through load bearing walls, concrete beams, fireproof walls, foundations, footings, and waterproof floors shall be Schedule 40 galvanized steel pipe or cast iron pipe.
- D. Sleeves for insulated piping shall be of sufficient internal diameter to take pipe and insulation and to allow for free movement of pipe. Waterproof sleeves shall be of sufficient internal diameter to take pipe and waterproofing material.
- E. In finished areas where pipes are exposed, sleeves shall be terminated flush with wall, partitions and ceilings, and shall extend 1/2 in. above finished floors. Extend sleeves 1 in. above finished floors in areas likely to entrap water and fill space between sleeves and pipe with graphite packing and caulking compound.
- F. Sleeves passing through membrane waterproofing or roofing shall be flashed and sealed.

2.5 PIPE ESCUTCHEONS

- A. Provide pipe escutcheons with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extensions, if any. Furnish pipe escutcheons with chrome finish for occupied areas, prime paint finish for unoccupied areas.
- B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.
- C. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.
- D. Manufacturer: Chicago Specialty; Producers Specialty; or Sanitary-Dash.

2.6 GUARDS

- A. Where exposed insulated piping extends through floor, provide sheet metal guard around insulation to extend up from floor 60 inches. Guard to be galvanized sheet steel not less than 26-gauge.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install pipe for plumbing and mechanical systems as shown on the Drawings, as called for in other Sections, and as specified herein

- B. Arrange and install piping approximately as indicated, straight, plumb, and as direct as possible, form right angles on parallel lines with building walls. Keep pipes close to walls, partitions, and ceilings, offsetting only where necessary to follow walls and avoid interference with other mechanical items. Locate groups of pipes parallel to each other; space at a distance to permit applying full insulation and to permit access for servicing valves. Piping to be run in concealed locations unless indicated exposed, or in equipment rooms.
- C. Install horizontal piping as high as possible without sags or humps so that proper grades can be maintained for drainage. Branch piping shall come off the tops of mains unless shown otherwise.
- D. Locate valves within reachable distance from equipment being served for easy access and operation. Do not locate valves with stems below horizontal.
- E. Check piping for interference with other trades; avoid placing water pipes over electrical equipment.
- F. Verify final equipment locations before roughing in.
- G. Where rough-ins are required for equipment furnished by others, verify exact rough-in dimensions with Owner or equipment supplier before roughing-in.
- H. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) and larger.
- I. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 - 1. Install hose-end drain valves at low points in water mains, risers, and branches.
 - 2. Install stop-and-waste drain valves where indicated.
- J. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 (DN 50) and smaller and butterfly valves for piping NPS 2-1/2 (DN 65) and larger. Balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."
- K. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Calibrated balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."

3.2 SLEEVES

- A. Install sleeves for piping passing through floors, roof, walls and foundations.
- B. Install fire-proofing per manufacturer's written instructions.

3.3 ESCUTCHEONS

- A. Install escutcheons for pipes entering finished spaces.

3.4 PIPE PENETRATIONS

- A. Penetrations shall be free of debris and dirt. Dam the penetration (when required) with an acceptable material. Apply firestop material to the penetration per manufacturer's installation instructions. Use a caulking gun, putty knife or other normal trade tools. Remove damming materials where necessary after cure. Clean up with Xylene.

3.5 FIELD QUALITY CONTROL

- A. Inspect domestic water piping as follows:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test domestic water piping as follows:
 - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.

3.6 ADJUSTING

- A. Perform the following adjustments before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.

4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.7 CLEANING

- A. Domestic water piping shall be cleaned and disinfected prior to substantial completion. Immediately prior to occupancy, the system(s) shall be flushed and a water sample submitted to the local Water Works for testing.
- B. Clean and disinfect potable domestic water piping as follows:
 1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures 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 (50 mg/L) 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 (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
 - (a) Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - (b) Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
- D. Prepare and submit reports of purging and disinfecting activities.

END OF SECTION 22 1116

**SECTION 22 1119
DOMESTIC WATER PIPING SPECIALTIES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide materials, equipment, labor, and supervision necessary to install water supply system as required by the Drawings and this Section.

1.2 CODES AND STANDARDS

- A. ASSE 1011 - Hose Connection Vacuum Breakers.
- B. ASSE 1012 - Performance Requirements for Backflow Preventer with Intermediate Atmospheric Vent.
- C. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principal Backflow Preventers.
- D. ASSE 1019 - Vacuum Breaker Wall Hydrants, Freeze Resistant Automatic Draining Type.
- E. ASSE 1048 - Performance Requirements for Double Check Detector Fire Protection Backflow Assemblies.
- F. ASSE 1052 - Performance Requirements for Hose Connection Backflow Preventers.
- G. ANSI / AWWA, C700
- H. The Plumbing and Drainage Institute - PDI Standard WH 201 for Water Hammer Arrestors
- I. Uniform Plumbing Code.
- J. NFPA Codes and Standards
- K. University of Southern California Foundation for Cross-Connection Control and Hydraulic Research - USCFCCC.
- L. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content =0.25% per Safe Drinking Water Act as amended January 4, 2011, Section 1417.
- M. NSF Compliance: NSF/ANSI 61 and/or NSF/ANSI 372 for valve materials for potable-water service. Valves for domestic water must be 3rd Party Certified.

1.3 SUBMITTALS

- A. Product data: Submit manufacturer's specifications and/or catalog data including material and pressure test certifications for all equipment herein.
- B. Installation, Operations and Maintenance data.
 - 1. Include signed copies of certified testing results reports.

1.4 EXTRA MATERIALS

- A. Furnish the following extra materials to Owner at the completion of the project:
 - 1. A spare service kit for each installed backflow preventer.
 - 2. Extra Hose End Vacuum Breakers for Hose Bibbs - One
 - 3. Extra Loose Keys for Exterior Wall Hydrants and Hose Bibbs: Two.

PART 2 PRODUCTS

2.1 GENERAL

- A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials that match pipe materials used in water supply systems. Where more than one type of material or product are indicated, selection is Installer's option.

2.2 WATER HAMMER ARRESTORS

- A. Water hammer arrestors shall be piston type of copper construction, sized and certified to function in accordance with PDI Standard WH 201.
- B. Units shall be pre-charged and suitable for operation in temperature 34° F to 250° F (1° C to 120° C) and maximum 150 psi (1000kPa) working pressure and shall be designed so as to limit surge pressure to 150 lbs. from a flow velocity of 10 fps at 60 psig through 50 feet of pipe the same size as the shock absorber.
- C. Manufacturer: Subject to compliance with requirements, provide water hammer arrestors manufacture by one of the following:
 - 1. Sioux Chief (piston type only, where specified)
 - 2. Watts
 - 3. Zurn
 - 4. JR Smith
 - 5. Wade
 - 6. Josam
 - 7. MIFAB
 - 8. Precision Plumbing Products
 - 9. Engineer approved equivalent

2.3 BACKFLOW PREVENTERS

- A. Backflow prevention devices shall be designed and tested for compliance with USCFCCC manual for cross connection control, and ASSE and AWWA standards as applicable to backflow prevention and cross connection control.

B. Reduced Pressure Principle Backflow Preventer

1. Reduced pressure-type backflow preventer shall consist of two independently operating, spring loaded check valves separated by an independent diaphragm type differential pressure relief valve located between check valves, provide third check valve that opens under backpressure in case of a diaphragm failure. Provide non-threaded drain connection with air gap and pipe to nearest floor drain.
2. Provide gate valves for shut-off duty on both sides of backflow preventer, an in-line strainer on upstream side of backflow preventer and four (4) test cocks.
3. Manufacturer: Subject to compliance with requirements, provide reduced pressure principal backflow preventer manufactured by one of the following:
 - a. Watts
 - b. Febco
 - c. Zurn, Wilkins Division
 - d. Engineer approved equivalent

2.4 THERMOSTATIC MIXING VALVES

- A. Valve shall be chrome-plated brass body with paraffin activation technology integral temperature adjustment. Reference plumbing fixture schedule for size and flow requirements.
- B. Cabinet shall be as scheduled for recessed or surface mounting with keyed lock.
- C. Manufacturer: Subject to compliance with requirements, provide valves manufactured by one of the following:
 1. Holby Valve Company
 2. Lawler
 3. Leonard
 4. Symmons Industries
 5. Powers
 6. Engineer approved equivalent

2.5 HOSE BIBBS

- A. Manufacturer: Subject to compliance with requirements, provide hose bibbs manufactured by one of the following:
 1. Woodford
 2. Watts
 3. Engineer approved equivalent
- B. Interior non-mixing type:
 1. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, with handwheel, and ASSE 1011 compliant vacuum breaker or ASSE 1052 compliant backflow preventer.

2.6 WALL HYDRANTS

- A. Manufacturer: Subject to compliance with requirements, provide wall hydrants manufactured by one of the following:
 - 1. Woodford
 - 2. Watts
 - 3. Engineer approved equivalent
- B. Freeze resistant, ASSE 1019, auto-draining, stainless steel stem, one piece valve plunger, copper casing tubes, wall clamp with polished finish, chrome plated box and lockable cover, hose thread spout, lockshield with removable key and ASSE 1052 approved backflow preventer.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Extend cold water and hot water piping to each fixture and other equipment requiring water supplies.
- B. Generally follow indicated lines, exact layout to be made on job for alignment with surrounding work and space for covering.
- C. Pitch pipes to accessible drainage point where unions, plugged tees or drainage valves shall be provided.
- D. Install water hammer arrestors on each service at each fixture or group of fixtures.
- E. Water supply to fixtures and containers shall be so installed as to prevent back siphonage of polluted water in to the water supply. Supplies shall be either above the flood rim of the fixture or separated from the drainage end by means of approved vacuum breakers.
- F. Provide valves as shown and specified herein. Branch serving four or more fixtures shall be provided with an accessible shut-off valve.
- G. Pipes built into masonry or concrete construction shall be wrapped with tar paper or burlap to prevent bonding to the concrete.
- H. No pipe shall be located in an outside wall or other location where freezing is likely to occur, and no pipe shall be in contact with or attached to a structural member in a manner that causes the transmission of noise to the structure. Block ends of runs to prevent movement due to water hammer.
- I. Consult with utility company for water meter requirements. Provide shut-off valves upstream and downstream of meters.
- J. Install approved backflow prevention devices on plumbing lines where contamination of domestic water may occur, including, but not limited to, the following locations. Install devices in accordance with manufacturer's instructions, complete with accessories as required.
 - 1. Interior and exterior hose connections
 - 2. Domestic Water Supply
- K. Extend relief piping from backflow prevention devices to nearest floor drain.
- L. Install water hammer arrestors, complete with accessible isolation valves on hot and cold water supply piping to all plumbing fixtures.

3.2 TESTING AND CLEANING

- A. Test, flush and clean domestic water piping specialties per Section 22 1116 " Domestic Water Piping" requirements and in compliance with the Uniform Plumbing Code. Certification of testing results shall be provided to Owner in writing.
- B. Backflow Prevention:
 - 1. After system test, flushing, and chlorinating, backflow preventer shall be disassembled by a certified backflow specialist and all debris shall be cleared from the valve, reassembled, and tested to verify proper operation.
 - 2. Inspect and flow test all backflow preventers in accordance with NFPA 13 and or NFPA 25 requirements and ASSE testing procedures and protocols.
 - 3. Certification of testing results shall be provided to Owner in writing

END OF SECTION 22 1119

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**SECTION 22 1123
DOMESTIC WATER PUMPS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Circulators.

1.2 REFERENCE STANDARDS

- A. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. NSF 61 - Drinking Water System Components - Health Effects; 2024.
- D. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Provide certified pump curve with duty point marked over pump and system operating conditions and NPSH curve and power requirement by pump tag.
 - 2. Manufacturer's catalog sheets for fixtures, fittings, accessories, and supplies.
- C. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

- A. Certifications: Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc, as suitable for purpose specified and indicated.
- B. Identification: Provide pumps with manufacturer's name, model number, and rated capacity identified by permanently attached label.
- C. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.6 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 5-year manufacturer warranty for circulators. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.1 CIRCULATORS

- A. Manufacturers:
 - 1. Bell & Gossett, a Brand of Xylem, Inc
 - 2. Armstrong Fluid Technology
 - 3. Grundfos Pumps Corporation
 - 4. Taco, Inc
- B. Casing: Bronze with bronze cast impeller, and stainless steel rotor assembly.
- C. Shaft: Alloy steel with integral thrust collar and two oil-lubricated bronze sleeve bearings.
- D. Mechanical Seal: Carbon rotating against a stationary ceramic seat.
- E. Pipe-End Connection: Union connection.
- F. Maximum Discharge Pressure: 145 psi (1000 kPa).
- G. Motor: 1,750 rpm, ECM duty with flexible coupling.
- H. Service Temperature Range: Minus 30 to 250 degrees F (Minus 34.4 to 121.1 degrees C).
- I. Controls: Provide

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install products with related fittings, and accessories according to manufacturer instructions.
- B. Potable and Drinking Water Service: Provide NSF 61 certified; comply with ICC (IPC).
- C. Ensure that small pressure gauges are installed on both upstream and downstream ends.
- D. Hot Water Service: Ensure that small pressure-temperature gauges are installed on both upstream and downstream ends.
- E. Factory-Provided Pump Controls: Factory provided, tested for use.
- F. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are nonoverloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

3.2 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Operational Tests: Upon completion and sterilization of plumbing systems, conduct operating tests to demonstrate satisfactory, functional, and operating efficiency.

3.3 CLEANING

- A. Thoroughly clean plumbing fixtures and equipment.

3.4 PROTECTION

- A. Protect installed products from damage due from subsequent construction operations.

B. Repair or replace products damaged before Date of Substantial Completion.

END OF SECTION

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**SECTION 22 1316
SANITARY WASTE AND VENT PIPING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide equipment, materials, tools, labor, and supervision necessary to furnish, fabricate, and install a complete soil, waste and vent system.

1.2 CODES AND STANDARDS

- A. Pipe materials specified in this Section shall apply to other technical sections of Division 22 of the Project Manual where applicable. Special requirements as may be called for in the technical sections, or shown on the Drawings, shall take precedence over General Requirements herein. Piping located in plenums shall be plenum rated for fire and smoke.
- B. Local and/or State Plumbing, Mechanical and Building Codes
- C. Uniform Plumbing Code
- D. NFPA Codes and Standards

1.3 PRODUCT HANDLING

- A. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage, and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.
- B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.
- C. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.

1.4 SUBMITTALS

- A. For each system served: Submit piping schedule listing, by range of sizes, piping material used.
- B. Submit product and performance data for equipment specified herein
- C. Locations of connections to existing sanitary sewer lines, storm water lines, and related invert elevations shall be submitted as a dimensioned drawing to the Owner's Representative or Architect/Engineer for construction record purposes.

PART 2 PRODUCTS

2.1 SANITARY SEWERS, SOIL, WASTE AND VENT MATERIALS

- A. Piping:

MATERIAL: SERVICE

Cast iron soil pipe, service weight, bell and spigot, ASTM A74, asphalt coated: Below grade Sanitary waste and vent piping. 3" dia. and larger.

Cast iron soil pipe, service weight, no hub, CISPI 301, ASTM A888. Above grade Sanitary waste and vent piping.

Copper water tube, hard temper, Type M, ASTM B88: Above grade vent up to and including 3" dia.

Copper drainage tube, hard temper, Type DWV, ASTM B306. Above grade vent up to and including 2 1/2" dia.

Solid wall Schedule 80 PVC pipe, ASTM D2665, (DWV) drain, waste and vent: Above and below grade Sanitary waste and vent piping.

B. Fittings

1. Material and strength of fittings for cast sewer pipes, clay sewer pipes, and concrete sewer pipe shall conform to pipe as per ASTM Standards.
2. Ductile iron and grey Iron fittings - Class 250, ANSI/AWWA C110 A21.10, standard mechanical joint fitting with lugs for connecting to pipe.
3. Copper drainage tube (M) - Cast bronze fittings, solder joint fittings. ANSI B.16, 23-69.
4. Solid wall Schedule 80 PVC DWV - solvent cemented joints per ASTM D2665.

C. Joints

1. Cast iron bell and spigot soil pipe - pipe manufacturer's standard preformed, preset plastic or rubber joint, installed in accordance with manufacturer's instructions.
2. Cast iron no-hub pipe - coupling assembly tightened by torque wrench.
 - a. Conforming to ASTM C1540 Performance Requirements, CISPI 310, and NSF certified, type 300 series stainless steel shield secured by two or more stainless steel worm drive clamps, ASTM C564 gasket, one piece neoprene compression gasket.
 - b. Manufacturers:
 - 1) Clamp All: Hi-Torq 80
 - 2) MG Coupling
 - 3) Ideal Tridon
 - 4) Engineer approved equivalent
3. Copper water and drainage tube - use 95-5 tin antimony or silver solder, cut pipe square, clean and polish tube ends and inner surface of fittings, apply flux and solder joint as recommended by manufacturer of solder type fittings. Use same methods for copper refrigerant pipe, except use silver solder with 15% silver content, equivalent to Sil-Flos 15.
4. Solid wall Schedule 80 PVC DWV - solvent cemented joints per ASTM D2665.

2.2 VENTS

- A. Vents through the roof shall be cast iron and shall extend at least above the highest possible water level on the roof but in no case less than 12 inches.
- B. Provide a flashing of 4 pound sheet lead for each vent through the roof. The flashing shall extend up around the pipe and turn down into it at least 2 in. and shall extend over the roof deck at least 1 ft. in each direction from the base.
- C. Coordinate flashing of vents through the roof with General Contractor.

- D. Where vents through the roof are subject to frost or snow closure the vent termination shall be increased beginning at least 12 in. under the roof with a cast iron long increaser. Size increasers as follows:

Vent Size	Increase To
1-1/4 in. and 1-1/2 in.	3 in. minimum
2 in. and 2-1/2 in.	4 in. minimum
3 in.	5 in.
4 in.	6 in.

2.3 SLEEVES

- A. Sleeves passing through non-load bearing walls and partitions shall be galvanized sheet steel with lock seam joints of minimum gauges as follows: For pipes 2-1/2" in size and smaller - 24-gauge; 3 in. to 6 in. - 22-gauge; over 6 in. - 20-gauge.
- B. Sleeves passing through load bearing walls, concrete beams, fireproof walls, foundations, footings, and waterproof floors shall be Schedule 40 galvanized steel pipe or cast iron pipe.
- C. Sleeves for insulated piping shall be of sufficient internal diameter to take pipe and insulation and to allow for free movement of pipe. Waterproof sleeves shall be of sufficient internal diameter to take pipe and waterproofing material.
- D. In finished areas where pipes are exposed, sleeves shall be terminated flush with wall, partitions and ceilings, and shall extend 1/2 in. above finished floors. Extend sleeves 1 in. above finished floors in areas likely to entrap water and fill space between sleeves and pipe with graphite packing and caulking compound.
- E. Sleeves passing through membrane waterproofing or roofing shall be flashed and sealed.

2.4 PIPE ESCUTCHEONS

- A. Provide pipe escutcheons with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extensions, if any. Furnish pipe escutcheons with chrome finish for occupied areas, prime paint finish for unoccupied areas.
- B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.
- C. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.
- D. Manufacturer: Chicago Specialty; Producers Specialty; or Sanitary-Dash.

2.5 GUARDS

- A. Where exposed insulated piping extends through floor, provide sheet metal guard around insulation to extend up from floor 60 inches. Guard to be galvanized sheet steel not less than 26-gauge.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install underground building drains as shown and in accordance with the Uniform Plumbing Code. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Clean interior of 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. Follow indicated lines generally but make exact layout on the job to work actual fitting dimensions, align piping, and avoid interference. Provide proper support to maintain uniform fall of 1/4 in. per ft. for lines 3 in. and smaller and 1/8 in. per ft. for lines larger than 3 inches. Protect openings against the entrance of dirt.
- C. No soil or waste pipe shall be covered by earth or concealed by construction without first being proven free of leaks by means of a hydrostatic water test of no less than 10-feet of head or pneumatic air test of no less than 5 PSI. Pressure shall be held constant for a period of not less than 15 minutes before beginning inspection or 15 minutes without the addition of air. Plastic pipe shall not be tested by air.
- D. Install vents in practical alignment and supported with constant pitch back to the drainage system, concealed from finished spaces, unless shown or directed otherwise.
- E. Soil, waste and vent connections to fixtures shall be accurately located and concealed from finished spaces, unless shown otherwise.
- F. Refer to Division 31 - Earthwork for excavating, trenching, and backfilling requirements.
- G. Contractor shall verify existing tie-in invert elevations of sanitary sewer piping prior to installation of new piping. Coordinate the site sewer tie-in invert elevation with the site utility contractor. Existing tie-in inverts that are discovered to be different from the information on the bid documents shall be reported to the General Contractor and the Engineer immediately.
- H. Install no-hub couplings and uniformly tighten clamps to manufacturer's recommended torque specifications. No-hub coupling joints shall be properly supported so as to not be exposed to bending.

3.2 SLEEVES

- A. Install sleeves for piping passing through floors, roof, walls, concrete beams, and foundations.
- B. Install fire-proofing per manufacturer's written instructions.

3.3 ESCUTCHEONS

- A. Install escutcheons for pipes entering finished spaces.

3.4 PIPE PENETRATIONS

- A. Penetrations shall be free of debris and dirt. Dam the penetration (when required) with an acceptable material. Apply fire stop material to the penetration per manufacturer's installation instructions. Use a caulking gun, putty knife or other normal trade tools. Remove damming materials where necessary after cure. Clean up with Xylene.

3.5 TESTING AND CLEANING

- A. Provide labor, materials, facilities, and administration required to conduct the tests required under this section. Tests which fail to meet the specified performance shall be retested at no expense to the Owner. Repair all defective installations.
- B. Flush out piping system with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.
- C. Testing shall be done in compliance with the Uniform Plumbing Code and to the satisfaction of the Authorities Having Jurisdiction.
- D. Perform final testing after all fixtures have been set and all traps have been filled with water.
- E. Hydraulic Water Testing:
 - 1. Hydraulically pressure test each section or segment of the soil, waste and vent system prior to backfilling, encasing, enclosing or otherwise preventing visual observation of the section or segment being tested or access to repair if needed.
 - 2. The system and all joints shall be tested with no less than 10 feet head of water pressure. Top of test standpipe to be filled with water shall be a minimum of 10 feet above the highest point of section being tested.
 - 3. The water shall be kept in the tested system or sub-section for not less than 15 minutes before inspection for leakage begins.
 - 4. All leaks shall be promptly repaired by replacing damaged or defective components with new parts and system shall be re-tested, repeating repair and re-testing steps as-needed, without additional cost to the Owner, until system is certified tight and leak free.
- F. Pneumatic Air Pressure Testing:
 - 1. Plastic piping shall not be tested with air. Do not overpressurize the system beyond maximum rating.
 - 2. Pneumatically pressure test with air each section or segment of the soil, waste and vent system prior to backfilling, encasing, enclosing or otherwise preventing visual observation of the section or segment being tested or access to repair if needed.
 - 3. The system and all joints shall be tested using an air compressor and pressure gauge or manometer testing apparatus.
 - 4. Fill tested system with air to a uniform, stabilized gauge pressure of 5 PSI. The system shall be held at the test pressure without the addition of air for a period of not less than 15 minutes.
 - 5. All leaks shall be promptly repaired by replacing damaged or defective components with new parts and system shall be re-tested, repeating repair and re-testing steps as-needed, without additional cost to the Owner, until system is certified tight and leak free.

END OF SECTION 22 1316

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**SECTION 22 1319
SANITARY WASTE PIPING SPECIALTIES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide equipment, materials, labor and supervision necessary to install soil, waste and vent system.

1.2 CODES AND STANDARDS

- A. Local and/or State Plumbing, Mechanical and Building Codes
- B. Uniform Plumbing Code
- C. NFPA Codes and Standards

1.3 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Floor drains.
 - 2. Cleanouts.
 - 3. Miscellaneous sanitary drainage piping specialties.

1.4 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene plastic.
- D. PE: Polyethylene plastic.
- E. PP: Polypropylene plastic.
- F. PVC: Polyvinyl chloride plastic.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated, include rated capacities, operating characteristics, and accessories.
- B. Installation, Operations and Maintenance data. Include signed copies of certified testing results reports.

1.6 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

PART 2 PRODUCTS

2.1 CLEANOUTS

A. General:

1. Floor:

- a. In floors of finished areas - epoxy coated, cast iron caulking ferrule for soil pipe hub with brass countersunk plug and cast brass round flush access cover with polished top. Furnish cleanout ID marker for all carpeted areas.
- b. In floors of unfinished areas - epoxy coated, cast iron with tapered body for caulking into soil pipe hub, with brass countersunk plug.

2. Wall:

- a. In walls of finished areas - Gas and water tight bronze tapered seat, raised head plug, iron pipe size (IPS) male threads and round polished stainless steel cover plate with countersunk stainless steel cover screw. Provide with caulking ferrule where installed in cast iron soil pipe.
- b. In walls of unfinished areas - Gas and water tight bronze tapered seat, raised head, iron pipe size (IPS) male threads. Provide with caulking ferrule where installed in cast iron soil pipe.

B. Manufacturers: Subject to compliance with requirements, provide clean outs by one of the following:

1. Zurn Plumbing Products Group
2. J.R. Smith
3. Wade
4. Watts Drainage Products Inc.
5. Engineer approved equivalent

2.2 FLOOR DRAINS

A. General:

1. Body: Floor and shower drains shall be epoxy coated cast iron with bottom outlet, convertible membrane clamp, adjustable collar with seepage slots.
2. Strainer: Polished heavy duty vandal-proof secured polished nickel bronze strainer and removable sediment bucket.
3. End Connections: hubless.

B. Sizes: Refer to Project Drawings and Schedules.

C. Traps and Seals:

1. Drains without integral traps shall have service weight cast iron P traps.
2. Provide trap primers on all floor drains and on other drains as shown on Drawings.

D. Manufacturers: Subject to compliance with requirements, provide clean outs by one of the following:

1. Zurn Plumbing Products Group
2. J.R. Smith
3. Wade
4. Watts Drainage Products Inc.
5. Engineer approved equivalent

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps

1. Description: Epoxy coated cast iron, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
 - a. NPS 2 (DN 50): 4-inch- (100-mm-) minimum water seal.
 - b. NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-) minimum water seal.

B. Expansion Joints

1. Description: ASME A112.21.2M compliant. Cast iron body with bronze sleeve, packing and gland.
2. End Connections: hub and spigot, hubless, or threaded. Match piping connections.
3. Size: Same as connected soil, waste, or vent piping.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install wood-blocking reinforcement for wall-mounting-type specialties.
- C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) 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 (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 1. Position floor drains for easy access and maintenance.

2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
5. Install deep-seal traps on floor drains, and other waste outlets unless otherwise indicated.
- F. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- G. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate size and location of roof penetrations.

3.3 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 PROTECTION

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

END OF SECTION 22 1319

**SECTION 22 3100
DOMESTIC WATER SOFTENERS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide equipment, materials, labor, and supervision necessary to install a complete domestic water softening system as required by the Project Drawings and this Specification.

1.2 CODE AND STANDARDS

- A. Softener tank shall be constructed in accordance with NSF/ANSI Standard 44.
- B. Softener tank shall be constructed and stamped in accordance with Section VII of ASME code for unlined pressure vessels for a working pressure of 100 PSIG
- C. Testing Standards:
 - 1. ASTM D 859, "Standard Test Method for Silica in Water."
 - 2. ASTM D 1067, "Standard Test Methods for Acidity or Alkalinity of Water."
 - 3. ASTM D 1068, "Standard Test Methods for Iron in Water."
 - 4. ASTM D 1126, "Standard Test Methods for Hardness in Water."
 - 5. ASTM D 1129, "Standard Terminology Relating to Water."
 - 6. ASTM D 3370, "Standard Practices for Sampling Water from Closed Conduits."

1.3 QUALIFICATIONS

- A. Manufacturer: A firm with at least 5 years of successful manufacturing of domestic water softening equipment.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with domestic water softening equipment.
- C. Provide water softening equipment manufactured by FilterTech or Engineer approved equivalent.

1.4 SUMMARY

- A. Provide as indicated a vertical pressure type water softener system complete with pressure vessels, brine tanks, softening resin, control valve, brine maker, and electronic controller.
- B. Refer to Water Softener Equipment Schedules which are located on the Project Drawings for system capacity information.

1.5 SUBMITTALS

- A. Submit initial facility water quality test report results.
- B. Submit product performance and installation data.
- C. Submit operational and effluent testing results reports.
- D. Submit Installation, Operations and Maintenance manuals.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Composite Fiberglass Softener Tanks:

1. The outer pressure vessel shell shall be constructed of continuous fiberglass roving.
2. The inner liner shall be Polyethylene.
3. Operating pressure - 150psi.
4. Operating temperature - 55 deg F

B. Brining System:

1. Tank shall be constructed of rigid polyethylene.
2. Brining systems shall be equipped with a float-operated plastic fitted brine valve and must allow for adjustment of the salt dosage without removing any parts.
3. Brining System shall be 30" dia. x 3' high with dry salt storage compartment, sufficient for at least 3 regenerations at full salting and a saturated brine compartment. Shall be equipped with a float-operated plastic fitted brine valve and allow for adjustment of the salt dosage without removing any parts. Tank shall be constructed of 3/16-in. thick fiberglass with cover.

C. Valves:

1. Main Operating Valve on each softener shall be automatic multi-port diaphragm type slow opening and closing and free of water hammer. The pressure-actuated valve shall move from one position to another without friction. There will be no contact between dissimilar metals within the valve. Parts subject to wear will be replaceable using common tools. The main control valve must be manufactured by the manufacturer of the softening equipment. Valve shall be equipped with an automatic self-adjusting brine injector to draw brine and rinse at a constant rate regardless of water pressure in the range 30 to 100 psi. Single units shall have an internal automatic bypass of untreated water during regeneration. Valve shall have a soft water sampling cock.
2. A Position Indicator will visually indicate the position of the valve at all times.
3. Isolation Valves - Each filter shall be equipped with full-port isolation ball valves at the inlet, outlet and brine line.

D. Pressure Gauges - Each softener shall be provided with two pressure gauges connected to hard water inlet and main water line.

E. Sampling cocks shall be furnished for hard water inlet and soft water outlet in each softener tank.

2.2 CONTROLS

- A. Shall have adjustable duration of the various steps in regeneration, shall allow for push-button start and also provide complete manual operation. Regeneration shall be initiated by an electric time switch providing fully automatic operation and adjustable to initiate regeneration at any hour of the day or days of the week.
- B. Sensor controlled regeneration - System shall automatically adjust and shall regenerate only when needed based on sensed raw water hardness and or flow demands.
- C. Flow Controls for backwash and flush shall be fully automatic requiring no field adjustment.

2.3 RESIN

- A. Resin shall be ResinTech CG8 or approved equal.

2.4 SKID FRAME

- A. Resin tank, brine tank, filter control valves, piping and appurtenances shall be mounted on a carbon steel powder-coated skid frame with square fiberglass grading.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install water softening equipment where shown in accordance with equipment manufacturer's written instructions and with industry practices.
- B. Provide air gap style piping termination for system discharge at adjacent mop basin or floor drain.
- C. Coordinate system electrical requirements with other trades.

3.2 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification in accordance with Section 22 0553 "Identification for Plumbing Piping and Equipment."

3.3 FIELD QUALITY CONTROL

- A. Start-Up Service:
1. Fill all brine tanks with water and processed plain salt pellets in accordance with Manufacturer's recommendations.
 2. Systems shall be tested and placed in proper working order by Factory Authorized Service Representative(s) or Technician(s) prior to substantial completion and before demonstration of systems to the Owner.
- B. Tests and Inspections:
1. Initial facility water quality testing:
 - a. Provide a full water quality analysis and report. Results of said report shall be used by manufacturer to determine final water softening equipment selections.
 2. Leak test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 3. Operational Tests:
 - a. After electrical circuitry has been energized, start units and confirm proper unit operation.
 - b. Test and adjust controls and safeties.
 - 1) Replace damaged or malfunctioning controls and equipment.
 - 2) Water softeners will be considered defective if they do not pass tests and inspections.
 - 3) Prepare and submit operational test and inspection reports.

4. Water Softener Effluent Tests
 - a. Sample water softener effluent after start up and at three consecutive seven-day intervals (total of four samples) prepare and submit certified test reports for required water performance characteristics.
 - b. Comply with the following ASTM Testing Standards:
 - 1) ASTM D 859, "Standard Test Method for Silica in Water."
 - 2) ASTM D 1067, "Standard Test Methods for Acidity or Alkalinity of Water."
 - 3) ASTM D 1068, "Standard Test Methods for Iron in Water."
 - 4) ASTM D 1126, "Standard Test method for Hardness in Water."
 - 5) ASTM D 1129, "Standard Terminology Relating to Water."
 - 6) ASTM D 3370, "Standard Practices for Sampling Water from Closed Conduits."
5. Demonstrations:
 - a. Prior to acceptance of the plumbing installation, Factory Authorized Service Representative(s) or Technician(s) shall demonstrate to the Owner or his designated representatives, essential features and functions of all systems installed, and instruct the Owner in the proper operation and maintenance of such systems.
- C. A complete set of operating instructions covering the installation, care and operation of the softener system and warranty documentation shall be furnished bound in booklet form.
- D. Warranty:
 1. The Manufacturer shall guarantee in writing that any mechanical equipment proving defective in workmanship or materials within one year after installation or initial start up shall be replaced at no additional cost.

END OF SECTION 22 3100

**SECTION 22 3300
ELECTRIC DOMESTIC WATER HEATERS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide materials, equipment, tools, labor and supervision necessary to install Electric Domestic Water Heaters as required by the Drawings and this Section.

1.2 CODES AND STANDARDS

- A. ASHRAE/ANSI/IES 90.1 - Energy Efficiency for Buildings Except Low-Rise Residential Buildings
- B. IECC - International Energy Conservation Code
- C. ASME Boiler and Pressure Vessel Code
- D. NFPA/NEC 70 - National Electrical Code
- E. UPC - Uniform Plumbing Code
- F. Local and/or State Plumbing, Mechanical and Building Codes
- G. NFPA Codes and Standards
- H. IAPMO, NSF and U.L. 174 or 1453 Listed
- I. Federal Energy Conservation Standards (2015)
- J. Any product used for dispensing potable water shall meet NSF 61 and NSF 372 testing standards. Third party testing shall be required.

1.3 SUBMITTALS

- A. Product Data: Submit product, dimensional, efficiency and performance data.
- B. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to water heaters. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- C. Installation, Operations and Maintenance data. Include wiring diagrams.

PART 2 PRODUCTS

2.1 ELECTRIC DOMESTIC STORAGE TANK WATER HEATERS

- A. Tank: Steel, glasslined, vermin-proof CFC foam insulation, stainless steel core anode corrosion protection. Outer jacket shall be baked enamel finish. 150 PSI rated working pressure.
- B. Heating Elements: Dual, medium wattage density, zinc plated copper sheath heating elements.
- C. Furnish with brass drain valve, thermometer and pressure gauges, and ASME rated T&P relief valve in accordance with State and local codes, regulations and ordinances.

- D. Electrical and Controls:
 - 1. Provide NEMA 4 electrical junction box with terminal block for wiring connections.
- E. Drain Pan: Furnish corrosion resistant material, water tight drain pan with 3/4 inch min. sized drain piping beneath water heaters.
- F. Warranty: 6-year tank and parts warranty.
- G. Water heater performance shall be as schedule on Drawings. Refer Schedules for energy efficiency factors, first hour ratings, recovery ratings, and storage capacity information.
- H. Acceptable Manufacturers: Subject to compliance with requirements, provide equipment by one of the following:
 - 1. A.O Smith
 - 2. State
 - 3. Lochinvar
 - 4. Rudd
 - 5. Patterson Kelly
 - 6. Engineer approved equivalent

2.2 EXPANSION - COMPRESSION TANKS

- A. Description: Steel, 150 psig max. pressure and 200 degree F max. temperature rated tank constructed with welded joints and factory installed butyl rubber diaphragm and rigid, mechanically bonded polypropylene liner. Include 20 psig air factory pre-charge.
- B. Construction:
 - 1. Tappings: Factory fabricated stainless steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe threads.
 - 2. Interior Finish: NSF 61 compliant barrier materials for potable water systems including fittings and outlets. All wetted components shall be of FDA approved materials.
 - 3. Air Charging Valve: Factory installed, Schrader valve for field charging.
- C. Capacity:
 - 1. Tank Capacity: 16.6 gallons minimum.
 - 2. Acceptance Volume: 11.3 gallons at 20 psig air side pressure.
 - 3. Air Pre-charge Pressure: 20 psi. Field adjust to system operating pressure.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Make hot and cold water piping connections including thermal checks.
- B. Route T & P relief valve piping to within 6 inches of floor.

END OF SECTION 22 3300

**SECTION 22 4000
PLUMBING FIXTURES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide fixtures, trim, accessories, labor, tools and supervision necessary to furnish and install plumbing fixtures as required by the drawings and this Section.

1.2 FIXTURE SCHEDULE

- A. Fixtures, trim, and accessories shall be of type and model numbers as scheduled on the drawings.

1.3 CODES AND STANDARDS

- A. IBC - International Building Code
- B. UPC - Uniform Plumbing Code
- C. PDI Compliance: Comply with standards established by PDI pertaining to plumbing fixture supports.
- D. ADA Compliance: Construct and install barrier-free plumbing fixtures in accordance with ADA and ANSI A117.1 requirements.
- E. Local and/or State Plumbing, Mechanical and Building Codes
- F. NFPA Codes and Standards
- G. IAPMO, NSF and U.L.
- H. Any product used for dispensing potable water shall meet NSF 61 and NSF 372 testing standards. Third party testing shall be required.

1.4 SUBMITTALS

- A. Submit Product Data which shall include product description, manufacturer, model, dimensions, size, rough-in requirements, connections to other equipment, construction materials and finishes, trim, accessory schedule, and performance data for each type of fixture.
- B. Submit manufacturers Installation Operation and Maintenance instructions. Include signed copies of certified testing reports.
- C. Submit to the General Contractor, cut-out trim plate for sinks which are to be installed in counter tops.

PART 2 PRODUCTS AND QUALIFICATIONS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products manufactured by one of the following, as listed for each type of fixture, or an Engineer-approved equivalent:
 - 1. Vitreous China Fixtures: American Standard and Kohler.
 - 2. Water Closet and Urinal Flush Valves: Sloan or Zurn
 - 3. Trim: Moen, Chicago Faucets, Delta Commercial, T&S Brass Works, or Sloan

- 4. Shower Valves: Bradley or Acorn
- 5. Fixture Carriers: Zurn, Wade, Josam, or J.R Smith
- 6. Janitor Sinks and Shower Bases: Crane-Fiat, Stern-Williams, or Swan
- 7. Toilet Seats: Bemis, Church, or Olsonite

2.2 VITREOUS FIXTURES

- A. Vitreousware shall be non-absorbent, even color, un-warped, two-fired vitreous china, grade A as rated by the Bureau of Standards.
- B. Vitreous fixtures shall be white, except where other colors are called for in schedule.

2.3 FLUSH VALVES

- A. Flush valves for handicapped fixtures shall be installed in compliance with ADA requirements and shall be installed with flush valve control mounted on wide side of toilet.
- B. Flush valves shall be installed with angle stop and vacuum breaker.

2.4 TRIM

- A. Trim shall include: Supply pipes, stop valves, faucets, tail pieces, strainers, wastes, traps, and floor and wall escutcheon plates which shall be brass. Exposed trim shall be chrome-plated.
- B. Stop valves shall be compression type with loose key handle control.
- C. P-traps shall be chrome-plated, adjustable cast brass with cleanout plug.
- D. Faucets shall contain standardized interchangeable operating units for both hand-closing and self-closing types, closing with the pressure of the water and containing a stamped Monel metal seat.

2.5 SHOWER VALVES

- A. Shower valves shall be mixing valve type, pressure balancing, with integral stops. Refer to Plumbing Fixture Schedule on Drawings for manufacturer and model numbers.

2.6 AERATORS

- A. Provide aerators of types approved by Health Departments having jurisdiction. Maximum flow to be 0.5 gpm in compliance with Energy Policy Act of 2005 and ASME/ANSI Standard A112.18.1M provide restrictive aerator as required.
- B. Comply with additional fixture requirements contained in fixture Schedule as shown on Drawings.

2.7 FIXTURE CARRIERS

- A. Provide cast-iron supports for fixtures of graphitic gray iron, ductile iron, or malleable iron as indicated. Provide floor mounted carriers for wall mounted fixtures.

2.8 FIXTURE BOLT CAPS

- A. Provide manufacturer's standard exposed fixture bolt caps finished to match fixture finish.

2.9 ESCUTCHEONS

- A. Where fixture supplies and drains penetrate walls in exposed locations , provide chrome plated sheet steel escutcheons with friction clips.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine roughing-in work of potable water and waste piping systems to verify actual locations of piping connections prior to installing fixtures. Also examine floors and substrates, and conditions under which fixture work is to be accomplished. Correct any incorrect locations of piping, and other unsatisfactory conditions for installation of plumbing fixtures. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION

- A. General: Install plumbing fixtures of types indicated where shown and at indicated heights; in accordance with fixture manufacturer's written instructions, roughing-in drawings, and with recognized industry practices. Ensure that plumbing fixtures comply with requirements of the Uniform Plumbing Code and Americans with Disability Act (ADA) Standards for Accessible Design pertaining to installation of plumbing fixtures.
- B. Fasten plumbing fixtures securely to indicated supports or building structure and ensure that fixtures are level and plumb. Secure plumbing supplies behind or within wall construction so as to be rigid and not subject to pull or push movement.
- C. Install fixtures and make water supply, waste, and vent connections as indicated on drawings.
- D. Set fixtures in center of stalls, between partitions where required. Dimensions for spacing shall be verified.
- E. Setting shall be absolutely tight and rigid on proper ground. All fixtures shall be sealed to structures (walls, floors, etc.) with non-mildew silicone caulk.
- F. Fixtures shall be covered with paper glued in place after they are set to prevent damage during the balance of construction, at the conclusion of work the paper shall be removed and the fixtures properly cleaned.
- G. The Contractor shall be responsible for the protection of the fixtures until acceptance by the Owner. Damaged fixtures shall be replaced at no additional cost to the Owner.
- H. All fixtures and accessories for handicapped use shall be installed in compliance with ADA requirements.

3.3 FIELD QUALITY CONTROL

- A. Upon completion of installation of plumbing fixtures and after units are water pressurized, test fixtures to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.
- B. Inspect each installed unit for damage to finish. If feasible, restore and match finish to original at site; otherwise, remove fixture and replace with new unit. Feasibility and match to be judged by Architect/Engineer. Remove cracked or dented units and replace with new units.

3.4 ADJUSTING AND CLEANING

- A. Clean plumbing fixtures, trim, and strainers of dirt and debris upon completion of installation.
- B. Adjust water pressure at drinking fountains, faucets, shower valves, and flush valves to provide proper flow stream and specified gpm.
- C. Adjust or replace washers to prevent leaks at faucets and stops.

END OF SECTION 22 4000

**SECTION 23 0500
COMMON WORK RESULTS FOR HVAC**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The work shall include the furnishings of systems, equipment and materials specified in this Division and as called for on the Mechanical Drawings to include supervision, quality control, operation, methods and labor for the fabrication, installation, start-up and tests for the complete mechanical installation. The work shall also include the furnishing of necessary hoisting facilities to set materials and equipment in place and the furnishing of any scaffolding and transportation associated with this work.
- B. Where noted on the drawings or where called for in other sections of the specification, the Contractor for this division shall install equipment furnished by others and shall make required service connections. Verify with the supplier of the equipment the requirements for the installation. This contractor shall be responsible for the removal and installation of railings, piping, ductwork, louvers, etc. as required to install new equipment. Coordinate shipping splits for all equipment provided by this contractor.

1.2 DAMAGE

- A. The Contractor shall be responsible for damage to the work of other trades or to the building and its contents, caused by equipment installation.

1.3 PERMITS AND INSPECTIONS

- A. Obtain and furnish necessary permits and inspection certificates for material and labor furnished. Permits and certificates shall be obtained from the proper inspection authorities. The cost of permits, certificates and fees required in connection with the installation shall be borne by the Contractor, unless otherwise noted in the detailed contractual description preceding these specifications. Where applications are required for the procuring of utility services to the building, see that such application is properly filed with the utility, and that information required for such an application is presented to the extent and in the form required by the utility company.

1.4 CODES AND STANDARDS

- A. Applicable provisions of the following codes and standards are hereby imposed on a general basis for the mechanical work (in addition to specific applications specified by individual work sections of these specifications):
 - 1. ASHRAE/IES 90.1 - Code for Energy Efficiency
 - 2. ANSI Pressure Piping Standards (B31)
 - 3. ASHRAE Safety Code for Mechanical Refrigeration (ANSI B9.1)
 - 4. AWWA Standards
 - 5. ASME Boiler and Pressure Vessel Code and State Boiler Code
 - 6. American Gas Association
 - 7. AWS Standards for Welding
 - 8. National Electrical Code

9. Local and/or State Plumbing, Mechanical and Building Codes
 10. Occupational Safety and Health Act (OSHA)
 11. International Energy Conservation Code
 12. Uniform Plumbing Code
 13. International Mechanical Code
 14. NFPA Standards and Pamphlets
- B. If any work indicated on the drawings or specified herein conflicts in any way with any of the rules and regulations of the above authorities, the Contractor shall notify the Architect/Engineer in writing 72 hours before bids are opened. In the event the Contractor fails to notify the Architect/Engineer and changes are required by said conflicts, the Contractor shall make such changes as are required without additional cost to this Owner.
- C. Installations must be safe in every respect and must not create a condition which will be harmful to building occupants; to operating, installing or testing personnel; to workmen; or to the public. The contractor for each installation shall be solely responsible for providing installations which will meet these conditions. If the Contractor believes that the installation will not be safe for all parties, report these beliefs in writing to the Architect/Engineer before any equipment is purchased or work is installed, giving recommendations. The Architect/Engineer will work out required changes and adjustments in contract price where adjustments are warranted.

1.5 DRAWINGS

- A. A complete set of drawings including civil, architectural, structural, mechanical, and electrical drawings shall be on the site at all times. Prior to installing any of the work, check the drawings for dimensions and see that the work does not interfere with clearance required for ceilings, beams, foundations, finished columns, pilasters, partitions and electrical equipment as shown on the drawings and details. After work is installed and it develops that interferences occur which have not been called to the Architect/Engineer's attention before the installation, the Contractor shall, at his own expense, make such changes in his work as directed by the Architect/Engineer.
- B. The contract drawings for mechanical work are in part diagrammatic, intended to convey the scope of work and indicate general arrangement and approximate sizes and locations of equipment and materials. Where job conditions require reasonable changes in indicated locations and arrangement, the Contractor shall make such changes as directed by the Architect/Engineer, without additional cost to the Owner.
- C. Because of the scale of the drawings, certain basic items such as pipe fittings, access panels, and sleeves may not be shown; but where such items are required by other sections of these specifications or where they are required by the nature of the work, they shall be furnished and installed. Rough-in dimensions and locations shall be verified with the supplier of equipment furnished by other trades, or by the Owner, prior to the time of roughing-in.
- D. Equipment specification may not deal individually with minute items required such as components, parts, controls and devices which may be required to produce the equipment performance specified, or as required to meet the equipment warranties. Where such items are required, they shall be included by the supplier of the equipment, whether or not specifically called for.

- E. The drawings and the specifications are cooperative and supplementary. It is the intent of both said drawings and specifications to cover all mechanical requirements in their entirety as nearly as possible. The Contractor shall closely check the drawings and specifications for any obvious errors or omissions and bring any such condition to the attention of the Architect/Engineer prior to the receipt of bids, in order to permit clarification by means of a mailed Addendum. If there is no question prior to the bid proposal date, the Architect/Engineer shall assume that the drawings and specifications are complete and correct and will expect the intent of said documents to be complied with, and the installation to be complete in all respects, according to said intent.
- F. Locate equipment which must be serviced, operated or maintained in fully accessible positions. Minor deviations from the contract drawings may be made to allow for better accessibility, but changes of magnitude, which involve extra cost, shall not be made without prior approval. Ample space shall be allowed for removal of parts that may require replacement or service in the future.

1.6 RESPONSIBILITY

- A. The Contractor's responsibility shall not end with the installation and connecting of the various apparatus. It shall include the services of an experienced superintendent, who shall be constantly in charge of the work, together with the qualified journeymen, helpers and laborers required to properly unload, install, connect, adjust, start, operate and test the work involved, including equipment and materials furnished by other trades or by the Owner, until such time as the entire mechanical installation functions properly in every detail.

1.7 COORDINATION

- A. Coordinate the work with other trades prior to installation.
- B. No piping, ducts or equipment foreign to the electrical equipment or architectural appurtenances shall be run over the top of any electrical panels or electrical equipment, in accordance with NEC 110-16 and 384-4. This does not prohibit sprinkler protection for the installation.
- C. The determination of quantities of material and equipment required shall be made from the drawings. Schedules on the drawings and in the specifications are completed as an aid, but where discrepancies arise, it shall be the Contractor's responsibility to provide the required quantity.
- D. Where the specifications state that equipment shall be furnished, installed or provided, it shall be understood to mean this Contractor shall furnish and install completely, unless it is specifically stated that the equipment is to be furnished and installed by others.
- E. The Architect/Engineer reserves the right to determine space priority of the contractors in the event of interference between the piping and equipment of the various contractors. Conflicts between the drawings and specifications, or between requirements set forth for the various trades, shall be called to the attention of the Architect/Engineer. If clarification is not asked for prior to the taking of bids, it will be assumed that none is required, and that the Contractor has submitted his bid in conformance with plans and specifications as issued and that no interference exists.

1.8 GUARANTEE AND MAINTENANCE

- A. Materials and equipment shall be guaranteed to be free from defects and to be new equipment; no secondhand, used or salvaged equipment will be allowed.

- B. Keep the entire portion of the work in repair, without additional cost to the Owner, so far as defects in workmanship, apparatus, material or construction are concerned for one (1) year from the date of final acceptance, except as otherwise specified herein.
- C. Equipment, which fails to meet performance ratings as specified and shown on the drawings, shall be removed and replaced by new equipment that meets the specified requirements, without additional cost to the Owner.
- D. Materials and workmanship shall be subject to the review of the Architect/Engineer, in whose presence various tests shall be made as required by these specifications.

PART 2 PRODUCTS

2.1 SUBMITTALS

- A. Submit shop drawings and catalog data for mechanical equipment as called for in Division 01.
- B. Submittal data for mechanical equipment shall consist of shop drawings and/or catalog cuts showing technical data necessary to evaluate the material or equipment to include dimensions, wiring diagrams, performance curves, rating, control sequence, and other descriptive data necessary to describe fully the item proposed and its operating characteristics. Shop drawings shall be submitted on equipment and materials as required by the specifications.
- C. Approval of materials, including alternate or substitute items, shall be obtained in writing from the Architect/Engineer, verbal approval will not be considered binding.
- D. Shop drawings shall be submitted and shall have been signed, checked, approved, and initialed by the Contractor prior to submittal to the Architect/Engineer. The Architect/Engineer will review shop drawings to aid in interpreting the plans and specifications and will in so doing assume that the shop drawings conform to specified requirements set forth in this specification. The approval of the shop drawing by the Architect/Engineer does not relieve the Contractor of the responsibility of complying with elements of the specification. The name of the job, Architect/Engineer, location, and specification section shall appear on all pages of shop drawings. Equipment marks (such as EF-1, RTU-1) shall be indicated for each item.
- E. At the completion of the job, furnish three (3) copies of parts lists, operating and maintenance instructions, and manuals organized and bound, in three books.
- F. At the completion of the project, prepare and submit to the Owner record drawings showing the location of piping and ductwork. Drawing shall give accurate dimensions of such equipment for future use by the Owner. This drawing shall be submitted as soon as work is completed and before authorization of final payment.

2.2 SUBCONTRACTORS AND MATERIALS

- A. Submit to the Architect/Engineer for review, when requested, a list of subcontractors, materials and equipment proposed to be used. The list must be reviewed by the Architect/Engineer before this Contractor may enter into any subcontractual agreement. Equipment, materials, and devices, etc. shall be subject to the review of the Architect/Engineer, whether or not said items are herein specified.

2.3 STANDARDS OF MATERIALS AND WORKMANSHIP

- A. Materials shall be new, complete with manufacturer's guarantee or warranty, and shall be as listed by Underwriters Laboratories (UL), Inc., Air Movement and Control Association (AMCA), American Gas Association (AGA), Air Conditioning and Refrigeration Institute (ARI), etc., if a standard has been established by that agency for the type of material.
- B. Materials shall also comply with applicable standards of the National Electrical Manufacturer's Association, National Board of Fire Underwriters, National Fire Protection Association, National Safety Council, National Bureau of Standards, the National Electrical Code and the Williams-Steiger Occupational Safety and Health Act of 1970. Such standards are hereby made a part of these specifications.
- C. Work shall be performed by workmen skilled in the particular craft, shall be executed in a workmanlike manner, and shall present a neat mechanical appearance when completed. Align, level and adjust equipment for satisfactory operation, and install so that connecting and disconnecting of piping and accessories can be made readily and so that parts are easily accessible for inspection, operation and maintenance. Methods and techniques of installation shall be subject to the review of the Architect/Engineer.
- D. Materials shall be the standard product of a reputable manufacturer regularly engaged in the manufacture of the specific product. Materials of the same type of class shall be the products of one manufacturer. For example, fans shall be from the same manufacturer and pumps from the same manufacturer.
- E. Materials shall be protected from damage and stored indoors or protected from the weather at all times, unless other storage arrangements are approved by the Architect/Engineer.
- F. Bearing lubrication fittings shall be as recommended by the manufacturer and shall be extended, where necessary, to an accessible location.
- G. Material and equipment shall be installed in strict accordance with the manufacturer's recommendations.

2.4 MATERIAL SUBSTITUTIONS

- A. Proposals as submitted shall be based on the products specifically named in the specification or on the drawings. Material or equipment by manufacturers other than those specified may be used only by permission of the Architect/Engineer. Such permission for substitution must be requested, in writing in accordance with Division 01.
- B. The Architect/Engineer reserves the sole right for the approval of proposed material or equipment, and the phrase, "or approved equivalent", used in these specifications, or on the drawings, shall be interpreted to mean an equivalent approved by the Architect/Engineer.
- C. Changes required by alternate equipment shall be made at no additional cost to the Owner; and costs incurred by other trades, public utilities or the Owner, as a result of the use of such equipment, shall be the responsibility of the Contractor.
- D. Furnish to the Architect/Engineer, when requested, samples of proposed material or equipment substitutions. These samples shall remain with the Architect/Engineer as long as needed.
- E. Identify the differences in alternate material or equipment as compared to that specified and indicate the benefits to the project as a result of selecting the alternative.
- F. The Architect/Engineer reserves the right to refuse approval of equipment which does not meet the specification, in their opinion, or of equipment for which no local experience of satisfactory service is available. The Architect/Engineer further reserves the right to reject equipment for which maintenance service and the availability of replacement parts is questionable.

PART 3 EXECUTION

3.1 OPENINGS, CUTTING, AND PATCHING

- A. The General Contractor shall coordinate the placing of openings in the new structure, as required for the installation of the mechanical work.
- B. Furnish to the General Contractor the accurate locations and sizes for required openings. This shall not relieve this Contractor of the responsibility of checking to assure that proper size openings are provided. When additional patching is required due to this Contractor's failure to inspect this work, this Contractor shall make arrangements for the patching required to properly close the opening, to include patch painting. This Contractor shall pay any additional cost incurred in this respect.
- C. When cutting and patching of the structure is made necessary due to this Contractor's failure to install piping, ducts, sleeves or equipment on schedule, or due to this Contractor's failure to furnish, on schedule, the information required for the leaving of openings, it shall be this Contractor's responsibility to make arrangements for this cutting and patching. This Contractor shall pay any additional cost incurred in this respect.
- D. Provide cutting and patching and patch painting in the existing structure, as required for the installation of the work. Furnish lintels and supports as required for openings. Cutting of structural support members will not be permitted without prior approval of the Architect/Engineer. Extent of cutting shall be minimized. Use core drills, power saws or other machines which will provide neat, minimum openings. Patching shall match adjacent materials and surfaces and shall be performed by craftsmen skilled in the respective craft required.

3.2 CONCRETE AND MASONRY WORK

- A. Concrete work included herein or shown on the drawings shall be done only by experienced cement finishers. Brickwork, where included, shall be laid only by experienced brick masons. Brick shall be of uniform size, hard burned, and shall be laid in cement mortar, except for patch work at a location where cement and lime mortar has previously been used. Exposed, finish brickwork shall match existing brickwork as closely as practical and shall be to the satisfaction of the Architect/Engineer and Owner.
- B. Concrete bases and pads for mechanical equipment will be furnished by General Contractor. This Contractor shall coordinate size and location.
- C. Furnish equipment anchor bolts and be responsible for their proper installation and accurate location.

3.3 ROOF OPENINGS

- A. Roof openings required by this Contractor that are not shown on the Structural or Architectural Drawings shall be cut and (if necessary) reinforced by an experienced roofing contractor.
- B. Roof penetrations for duct and piping shall be through curbed roof openings. Equipment supports shall be by curbed and flashed runners meeting current National Roofing Contractor Association (NRCA) standards and details. Pitch pockets, pitch pans, and wood blocking are not acceptable.
- C. All roof work shall be completed such that it does not void any existing roof warranty.

3.4 CLEANING

- A. Keep the premises clean of all debris. caused by the work as described in DIVISION 01.

- B. At the conclusion of the construction, the site shall be thoroughly cleaned of all rubble, debris and unused material and shall be left in good order. Closed off spaces shall be cleaned of waste such as material, cartons, and wood frame members used in the construction.

3.5 WIRING FOR MECHANICAL EQUIPMENT

- A. The electrical contractor will provide power to and connection of motors and equipment furnished by this Contractor. Where disconnect switches are not specified to be furnished with the equipment, the electrical Contractor will furnish disconnect switches for equipment furnished by this Contractor.
- B. Provide integral wiring, alarm wiring, control wiring, temperature control wiring and interlock wiring for equipment furnished, whether or not such wiring is furnished by the equipment vendor.
- C. Except where other Sections call for starters to be furnished by manufacturers as part of their equipment, the electrical contractor will furnish motor starters for motors furnished by this Contractor.
- D. Furnish to the electrical contractor, shop drawings and a schedule for motors and other mechanical equipment furnished, which require electrical services. The schedule shall include the locations for rough-ins, electrical loads, size, and electrical characteristics for services required.
- E. Additional costs incurred, where motors or equipment furnished by this Contractor require larger services or services of different electrical characteristics than those called for on the Electrical Drawings, due to the Contractor furnishing substitute equipment, shall be paid for by this Contractor.
- F. Review the Electrical Drawings and call to the attention of the Architect/Engineer, prior to bidding, omissions of electrical services required for equipment.
- G. Mechanical equipment which requires fuse protection, to maintain UL listing, shall be coordinated with the electrical contractor to provide such protection.

3.6 MOTORS

- A. TEFC and ODP motors for equipment supplied by this contractor shall meet or exceed the listed values when tested in accordance with IEEE Standard 112 Method B as defined by NEMA Standard MG 1-12.6C. Efficiency values listed are based on NEMA Premium Efficiency Motors of NEMA MG 1-2003, Table 12-12 at 1800 RPM:

HP	ODP	TEFC
1	85.5	85.5
1.5	86.5	86.5
2	86.5	86.5
3	89.5	89.5
5	89.5	89.5
7.5	91.0	91.7
10	91.7	91.7
15	93.0	92.4
20	93.0	93.0
25	93.6	93.6
30	94.1	93.6

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40	94.1	94.1
50	94.5	94.5
60	95.0	95.0
75	95.0	95.4
100	95.4	95.4
125	95.4	95.4
150	95.8	95.0
200	95.8	95.0

- B. All motors that are indicated to be used with Variable Frequency Drives (VFDs) shall be inverter duty rated. Coordinate all motor requirements with the electrical contractor.

3.7 PROTECTION

- A. Special care shall be taken for the protection of equipment furnished by this Contractor. Equipment and material shall be protected from elements such as weather, painting and plastering until the project is completed. Damage from rust, paint or scratches shall be repaired as required to restore equipment to original condition.
- B. Protection of equipment during the plastering and painting of the building shall be the responsibility of the contractor performing that work, but this shall not relieve this Contractor of the responsibility of checking to assure that adequate protection is being provided.
- C. Where the installation or connection of equipment requires this Contractor to work in areas previously finished by other contractors, this Contractor shall be responsible that such areas are protected and are not marred, soiled or otherwise damaged during the course of such work. This Contractor shall arrange with the other contractors for repairing and refinishing of such areas which may be damaged.
- D. When heavy materials must be placed upon or transported over the roof deck, sheeting shall be placed to distribute the weight and support such materials. Any damage shall be immediately corrected at no cost to the Owner.

3.8 NOISE AND VIBRATION

- A. Be responsible for the installation of all equipment in such a manner as to control the transmission of noise and vibration from any installed equipment or system, so that the sound level does not exceed NC35 in any occupied space. Be responsible for the correction of any objectionable noise in any occupied area due to improperly installed equipment.

3.9 TESTS AND DEMONSTRATIONS

- A. Systems shall be tested and placed in proper working order prior to demonstrating systems to the Owner.
- B. Prior to acceptance of the mechanical installation, demonstrate to the Owner or his designated representatives essential features and functions of all systems installed, and instruct the Owner in the proper operation and maintenance of such systems.
- C. Furnish the necessary trained personnel to perform the demonstrations and instructions and arrange to have the manufacturer's representatives for the system present to assist with the demonstrations. The Owner and Contractor shall each sign a certification stating that the training has been performed and the Owner accepts same.

3.10 UTILITY REBATE APPLICATIONS

- A. This contractor shall be responsible for gathering information necessary for completing local utility rebate applications and submitting to the proper utility companies for gas and electric rebates. Potential rebates include high efficiency gas boilers, thermostats, timeclocks, motors, and other items furnished by this mechanical contractor.

END OF SECTION

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**SECTION 23 0529
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide equipment, materials, labor and supervision necessary to install pipe hangers and supports.
- B. Pipe support systems shall secure pipes in place, prevent pipe vibration, provide vertical adjustment for maintaining required grades, and provide for expansion and contraction.
- C. Where supports are attached to concrete or other structural members, care shall be taken to prevent damage or weakening of the structural members.
- D. Where concrete inserts are to be used, it shall be this Contractor's responsibility to accurately locate and attach inserts to concrete forms.

1.2 REFERENCES

- A. American National Standards Institute, ANSI:
- B. ANSI B31.1: Power Piping
- C. Manufacturers Standardization Society of the Valve and Fittings Industry, MSS, 1815 North Fort Myer Drive, Arlington, VA 22209.
 - 1. MSS SP-58: Materials Standardization Society: Pipe Hangers and Supports-Materials, Design, and Manufacturer.
 - 2. MSS SP-69: Materials and Standardization Society: Pipe Hangers and Supports - Selection and Application.
 - 3. NFPA 13-Standard for the Installation of Sprinkler Systems.
 - 4. ASTM A123-Specification for Zinc Hot-Galvanized Coatings by the Hot Dip Process.
 - 5. ASTM A653 G90-Specification for Steel Sheet, Zinc on Iron and Steel.

1.3 SUBMITTALS

- A. Submit manufacturer's product data on all hangers and support devices. Product data to include, but not be limited to materials, finishes, approvals, load ratings, and dimensional information.

PART 2 PRODUCTS

2.1 HANGERS AND SUPPORTS

- A. Hangers and support devices shall be Anvil International Inc., Tolco, Fee and Mason, Michigan, B-Line or approved equivalent. Figure numbers based on Anvil.

PART 3 EXECUTION

3.1 INSTALLATION - HORIZONTAL PIPE SUPPORTS

- A. Hanger rods for steel, wrought iron and brass pipe shall be installed in accordance with MSS SP-69 Tables 3 and 4 and the following schedule:

Pipe Size	Rod Diameter	Maximum Spacing
Up to 1-1/4"	3/8"	7'-0"
1-1/2" and 2"	3/8"	9'-0"
2"	3/8"	10'-0"
2-1/2", 3" and 3-1/2"	1/2"	10'-0"
4" and 5"	5/8"	12'-0"
6"	3/4"	12'-0"
8"	7/8"	14'-0"
10" and 12"	7/8"	16'-0"
14" and 16"	1"	16'-0"
18"	1-1/8"	18'-0"
20" and 24"	1-1/4"	20'-0"

- B. Hanger rods for copper pipe and tube shall be installed in accordance with MSS-SP-69 Tables 3 and 4 and the following schedule:

Pipe Size	Rod Diameter	Maximum Spacing
1/2" and 3/4"	3/8"	5'-0"
1"	3/8"	6'-0"
1-1/4"	3/8"	7'-0"
1-1/2"	3/8"	8'-0"
2"	3/8"	8'-0"
2-1/2"	1/2"	9'-0"
3", 3-1/2" and 4"	1/2"	10'-0"
5"	1/2"	13'-0"
6"	5/8"	14'-0"
8"	3/4"	16'-0"

- C. In addition to the above specified spacings, install additional hangers at change in pipe direction and at concentrated loads, large valves and strainers.
- D. Where more than one pipe is to be run parallel together, they may be supported on trapeze type hangers. Trapeze bar angles and hanger rods shall be of sufficient size to support the particular group of pipes. Trapeze hanger spacing shall be based on the smallest pipe on the rack. When hanging from light gauge metal trusses, coordinate pipe hanger spacing and hanger rod connection points with the truss manufacturer.
- E. For suspending hanger rods from brackets attached to walls, use welded steel brackets; Fig. 194 for loads up to 750 lbs; Fig. 195 for loads up to 1500 lbs; Fig 199 for loads up to 3000 lbs.
- F. Where pipes are to be racked along walls, use "Unistrut" pipe racks or 12 gauge steel strut channel, 1-5/8" x 1-5/8" minimum.
1. Mount pipes to strut channel with two-piece pipe straps to match outside diameter of pipe including insulation.

- G. Attach all pipe hangers from support rods using double locknuts tightened to prevent loosening.

3.2 INSTALLATION - VERTICAL PIPE SUPPORTS

- A. Support vertical steel, wrought iron, copper and brass pipe at every other floor line.
- B. Support vertical cast iron soil pipe at every floor line.
- C. In addition to the above, support vertical pipes at base of riser with base fitting set on concrete or brick pier, or by hanger located on horizontal connection close to riser.
- D. Where pipe sleeves extend above floor, place pipe clamps at ceiling below and support clamp extensions from inserts or other approved attachment.

3.3 PIPE ATTACHMENTS

- A. For horizontal steel and wrought iron pipe, use carbon steel adjustable clevis hanger, Fig. 260. For floor support or support directly above steel beams, use pipe roll stand, Fig. 177.
- B. For horizontal copper pipe and tube, use copper-plated adjustable swivel ring, Fig. CT-69.
- C. When thermal expansion for horizontal pipe is in excess of ½" axially, use adjustable swivel pipe roll, Fig. 181, or pipe roll stand, Fig. 177.
- D. For horizontal cast iron soil pipe, use clevis hanger, Fig. 260.
- E. For vertical, steel, wrought iron and cast iron pipe, use extension pipe clamps, Fig. 261.
- F. For vertical copper pipe and tube, use copper-plated extension pipe clamp, Fig. CT-121.

3.4 INTERMEDIATE ATTACHMENTS

- A. Hanger rods: use carbon steel single or double end threaded, Figs. 140, 253 as required. Continuous threaded rod: Fig. 146 may be used wherever possible.
- B. Chain wire or perforated strap hangers will not be permitted. One pipe shall not be suspended from another pipe.

3.5 STRUCTURAL ATTACHMENTS

- A. For attaching steel or copper plated hanger rods to reinforced concrete, use galvanized malleable iron concrete inserts; Fig. 282 for loads up to 1140 lbs.
- B. For attaching steel hanger rods to structural steel beams, use malleable iron C-clamps; Fig. 92, Fig. 93 or Fig. 94 with retaining clip Fig. 89 or Fig. 89X for loads up to 500 lbs; Fig. 218 with extension piece for loads up to 1,365 lbs. For copper plated hanger rods, use copper plated malleable iron C-clamps; Fig. CT-138R for loads up to 180 lbs.
- C. For attaching steel hanger rods to wood structural members, use malleable iron ceiling flange; Fig. 153 for loads up to 1,270 lbs. For copper plated hanger rods, use copper plated malleable iron ceiling flange: Fig. CT-128R for loads up to 180 lbs.
- D. Vertical expansion shields or toggles shall not be used for suspending hanger rods, except with permission in cases where inserts have been omitted or cannot be used. If permitted, use expansion shields; for rod sizes up to ½", 320 lbs. max. load. For hanger rods larger than ½" use attachment plate, Fig. 52, with wedge anchors.
- E. Powder actuated anchoring methods shall not be used.

3.6 PIPE COVERING PROTECTION

- A. Hangers and supports for insulated piping shall not injure or pierce insulation. Provide insulation protection shields in conjunction with hanger or roll device. Use Fig. 160 and 165, Protection Saddles.

3.7 SUPPLEMENTAL STEEL

- A. Provide supplemental steel required to hang or support mechanical equipment or piping.

END OF SECTION

**SECTION 23 0553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide materials, equipment labor and supervision necessary to install piping identification products.
- B. Comply with ANSI A13.1 for lettering size, length or color field, colors, and installed viewing angles of identification devices.

1.2 QUALIFICATIONS

- A. Brady Corp., Industrial Safety Supply, Emedco, Seton or Brimar.

1.3 SCHEDULES

- A. Submit valve and damper schedule for each system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve and damper number, system, system abbreviation (as shown on tag), location of valve and damper (room or space), and variations for identification (if any). Mark valves and dampers that are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule.

1.4 SUBMITTALS

- A. Submit manufacturer's product data.
- B. Submit sample of each type of identification product and clearly identify the contents in a schedule.

PART 2 PRODUCTS

2.1 PIPE MARKERS

- A. Provide manufacturer's standard preprinted, semi-rigid snap-on or self-sticking, color-coded pipe markers, complying with ANSI A13.1.
- B. Provide full-band pipe markers, extending 360° around pipe at each location or self-sticking pipe markers, fastened in the following method:
 - 1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
 - 2. Secure to piping and install banding tape on both ends of each pipe label.
- C. Lettering shall be manufacturer's pre-printed nomenclature which best describes piping system in each instance, as selected by Architect/Engineer in cases of variance.
- D. Print each pipe marker with arrows indicating direction of flow, integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic or on banding tape.

2.2 EQUIPMENT MARKERS

- A. Provide engraved signage nameplates and tags constructed of multi-layered acrylic that has been treated for outdoor use and can withstand temperatures up to 160° F. Nameplates shall have beveled edges with contrasting color core, letters, and border. Minimum size of nameplate shall be 3" high by 6" long. The minimum letter height shall be 3/4". Attachment shall be by double faced 2 mil permanent acrylic adhesive. For equipment that doesn't allow for direct attachment, furnish sheet metal backing to integrate with equipment such that signage can be read from 5 feet above the finished floor. Unless noted otherwise, signage shall be provided with black lettering, black border, and yellow core. All signage shall include up to 14 characters per line, minimum of 3 lines per tag. Furnish signage for equipment shown in Section 3:
 - 1. All pumps shall include the full name description for system served such as "Primary Chilled Water Pump – 1."
 - 2. All air handling unit filter sections shall be labeled with the exact quantity of filters, size, and type of filter such as "14 – 24"x24"x2", 30% Pleated Filters."
- B. All equipment shall be named consistent with the plans and specifications as indicated on the schedules or as directed by the Owner.

2.3 BRASS VALVE AND DAMPER TAGS

- A. Provide manufacturer's standard brass valve and damper tags with stamped black filled lettering, with piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 3/16" hole for fastener.
- B. Provide 1-1/2" round brass tags with black lettering. Seton 250 BL or equal.

2.4 VALVE AND DAMPER TAG FASTENERS

- A. Manufacturer's standard solid brass chain or solid brass S-hooks of sizes required for proper attachment of tags to valves and dampers and manufactured specifically for that purpose.

2.5 VALVE AND DAMPER SCHEDULE FRAMES

- A. For each page of schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSD-grade sheet glass.

PART 3 EXECUTION

3.1 INSTALLATION OF MECHANICAL IDENTIFICATION

- A. Where identification is to be applied to surfaces that require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.
- B. Install pipe markers on each system and include arrows to show normal direction of flow.

- C. Locate pipe markers as follows: wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) above lay-in type ceilings and exterior non-concealed locations.
 - 1. Near each valve and control device.
 - 2. Near each branch, excluding short take-offs for fixtures, mark each pipe at branch where there could be question of flow pattern.
 - 3. Near locations where pipes pass through walls or floors/ceilings, (both sides) or center non-accessible 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. At each pipe passage to underground.
 - 7. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.
 - 8. On piping above removable acoustical ceilings, maximum spacing of 20' along each piping run.
 - 9. Where self-sticking labels are used, the pipe or its covering surface shall be properly prepared. This consists of removal of loose dirt, oil and grease, loose paint or peeling insulation covering. This can be done with a brush and cloth; washing is not required. Use solvent for removal of oil or grease.
 - 10. Banding tape must be used on both ends of all self-sticking labels. The tape shall encircle the pipe completely and overlap itself so the banding tape can adhere to itself.
- D. Provide valve tags for all major valves 3/4" size or larger. Included are all main, zone and branch valves, valves in all equipment rooms, etc. All types of valves, ball, globe, butterfly, cocks, control, regulating, relief, reducing, solenoid, etc. are to be identified except check valves. Do not identify end use point valves for plumbing fixtures, and similar rough-in connections.
- E. Provide damper tags on all automatic control dampers, motorized dampers, and smoke dampers.
- F. List each tagged valve and damper in schedule for each system showing function and location. Provide separate charts for mechanical divisions of work. Charts shall be installed on a conspicuous wall in the main mechanical equipment room. Provide unframed copies of valve and damper lists as part of closeout documents.

3.2 ADJUSTING AND CLEANING

- A. Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.
- B. Clean face of identification devices and glass frames of valve schedules.

3.3 PIPING DUCTWORK, AND EQUIPMENT IDENTIFICATION

- A. Piping systems that shall be identified by their controls (including directional arrows) on this project shall include, but are not necessarily limited to, the following:
 - 1. Geothermal water (supply and return).

B. Equipment/Ductwork

1. Outdoor air intake plenums.
2. Air handling unit sections.
3. Air separator.
4. Pumps.
5. Glycol Feeders.
6. Directional arrows indicating flow of air at discharge and inlet of air handling units.
7. Provide name plates for all equipment scheduled on the drawings. Coordinate nameplate tag with Owner's sequencing system. If the Owner has no preference, the nameplates shall correspond with the equipment schedule.
8. All labeling for the machinery refrigeration room shall be in accordance with ASHRAE 15.

END OF SECTION

SECTION 23 0593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic, steam, and refrigeration systems.
- C. Measurement of final operating condition of HVAC systems.

1.2 QUALIFICATIONS

- A. Testing and balancing shall be performed by an independent certified testing and balancing contractor. The Contractor shall be certified by the AABC (American Association of Balancing Contractors), NEBB (National Environmental Balancing Bureau), or SMARTA (Sheet Metal and Air Conditioning and Roofing Trade Association). The Balancing Contractor shall provide labor, services, and test equipment required to test, adjust, and balance the specified systems. Personnel involved in the execution of the work under the Balancing Contract shall be experienced and trained in the total balancing of mechanical systems, as well as being regular employees of the Balancing Contractor.

1.3 SUBMITTALS

- A. Submit under provisions of Division 01.
- B. Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.
- C. Field Reports: Submit under provisions of Division 01.
- D. Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- E. Prior to commencing work, submit report forms or outline indicating adjusting, balancing, and equipment data required.
- F. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.
- G. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
- H. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty prior to commencing system balance.
- I. Test Reports: Indicate data on forms containing information indicated in Schedules.

1.4 SEQUENCING

- A. Sequence work to commence after completion of systems installation and schedule completion of balancing work before Substantial Completion of Project.
- B. Do not proceed with balancing work until systems scheduled for testing, adjusting, and balancing are clean and free from debris, dirt, and discarded building materials.

PART 2

2.1 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 OTHER CONTRACTOR RESPONSIBILITIES

- A. The Mechanical and Plumbing Contractors shall cooperate with the balancing agency by:
 - 1. Including balancing dampers as required by the Drawings and Specifications.
 - 2. Putting complete system into operation during duration of balancing period.
 - 3. Providing up-to-date set of Drawings and advising immediately of changes made to the system during construction.
 - 4. Providing labor and equipment and cost of performing corrections such as dampers, belts, and pulley changes, etc. as required without undue delay.
 - 5. Providing complete submittal information for mechanical equipment complete with pertinent engineering information.

3.2 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions.
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
 - 12. Hydronic systems are flushed, filled, and vented.
 - 13. Pumps are rotating correctly.
 - 14. Proper strainer baskets are clean and in place.
 - 15. Service and balance valves are open.
- B. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.
- C. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

- A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.
- B. Provide additional balancing devices as required.

3.4 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 of design for return and exhaust systems.
- B. Diffusers, Registers and Grilles: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust diffusers, registers and grilles in space to within plus or minus 10 percent of design.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.5 ADJUSTING

- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostat to specified settings.
- E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- F. Check and adjust systems approximately six months after final acceptance and submit report.

3.6 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowance for 50 percent loading of filters.

- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries, 0.02 inches positive static pressure in. and -0.02 inches negative static pressure at..
- M. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.
- N. On fan powered VAV boxes, adjust air flow switches for proper operation.
- O. Air ducts with electric heating coils shall be adjusted to allow coil to energize at minimum air flow conditions.

3.7 WATER SYSTEM PROCEDURES

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.
- G. Three way valves shall be tested and balanced for flow capacities at full coil flow and full bypass flow, as indicated on the drawings or at a maximum coil flow, whichever is less.

3.8 SCHEDULES

- A. Equipment Requiring Testing, Adjusting, and Balancing
 - 1. HVAC Pumps
 - 2. Heat Pump
 - 3. Grilles

B. OUTDOOR AIR VENTILATION DATA

1. Heat Pump Units shall be tested and balanced for the following conditions:
 - a. Leakage when the outdoor air damper is in the closed position and the unit is operating at 100% scheduled speed. Adjust damper if required to reduce leakage to the maximum allowable leakage rate as specified.
 - b. Capacity as scheduled on the drawings
2. Coordinate testing with the temperature controls contractor and identify the % actuator stroke correlating with the above capacities.
3. Submit this in report form to the engineer prior to submitting final report.

C. REPORT FORMS

1. Title Page:
 - a. Name of Testing, Adjusting, and Balancing Agency
 - b. Address of Testing, Adjusting, and Balancing Agency
 - c. Telephone number of Testing, Adjusting, and Balancing Agency
 - d. Project name
 - e. Project location
 - f. Project Architect
 - g. Project Engineer
 - h. Project Contractor
 - i. Project altitude
 - j. Report date
2. Summary Comments:
 - a. Design versus final performance
 - b. Notable characteristics of system
 - c. Description of systems operation sequence
 - d. Summary of outdoor and exhaust flows to indicate amount of building pressurization
 - e. Nomenclature used throughout report
 - f. Test conditions
3. Instrument List:
 - a. Instrument
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Range

- f. Calibration date
- 4. Electric Motors:
 - a. Manufacturer
 - b. Model/Frame
 - c. HP/BHP.
 - d. Phase, voltage, amperage; nameplate, actual, no load
 - e. RPM
 - f. Service factor
 - g. Starter size, rating, heater elements
 - h. Sheave Make/Size/Bore
- 5. V-Belt Drive:
 - a. Identification/location
 - b. Required driven RPM
 - c. Driven sheave, diameter and RPM
 - d. Belt, size and quantity
 - e. Motor sheave diameter and RPM
 - f. Center to center distance, maximum, minimum, and actual
- 6. Pump Data:
 - a. Identification/number
 - b. Manufacturer
 - c. Size/model
 - d. Impeller
 - e. Service
 - f. Design flow rate, pressure drop, BHP
 - g. Actual flow rate, pressure drop, BHP
 - h. Discharge pressure
 - i. Suction pressure
 - j. Total operating head pressure
 - k. Shut off, discharge and suction pressures
 - l. Shut off, total head pressure
- 7. Electric Duct Heater:
 - a. Manufacturer

- b. Identification/number
 - c. Location
 - d. Model number
 - e. Design kW
 - f. Number of stages
 - g. Phase, voltage, amperage
 - h. Test voltage (each phase)
 - i. Test amperage (each phase)
 - j. Air flow, specified and actual
 - k. Temperature rise, specified and actual
 - l. Static pressure required for air flow switch
8. Air Moving Equipment
- a. Location
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Arrangement/Class/Discharge
 - f. Supply air flow, specified and actual
 - g. Return air flow, specified and actual
 - h. Outside air flow, specified and actual
 - i. Total static pressure (total external), specified and actual
 - j. Inlet pressure
 - k. Discharge pressure
 - l. Sheave Make/Size/Bore
 - m. Number of Belts/Make/Size
 - n. Fan RPM
 - o. Fan BHP
9. Return Air/Outside Air Data:
- a. Identification/location
 - b. Design air flow
 - c. Actual air flow
 - d. Design return air flow

- e. Actual return air flow
 - f. Design outside air flow
 - g. Actual outside air flow
 - h. Return air temperature
 - i. Outside air temperature
 - j. Required mixed air temperature
 - k. Actual mixed air temperature
 - l. Design outside/return air ratio
 - m. Actual outside/return air ratio
10. Duct Traverse:
- a. System zone/branch
 - b. Duct size
 - c. Area
 - d. Design velocity
 - e. Design air flow
 - f. Test velocity
 - g. Test air flow
 - h. Duct static pressure
 - i. Air temperature
 - j. Air correction factor
11. Air Distribution Test Sheet (Diffusers, Registers and Grilles):
- a. Air terminal number
 - b. Room number/location
 - c. Terminal type
 - d. Terminal size
 - e. Area factor
 - f. Design velocity
 - g. Design air flow
 - h. Test (final) velocity
 - i. Test (final) air flow
 - j. Percent of design air flow

END OF SECTION

**SECTION 23 0700
HVAC INSULATION**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide equipment, materials, labor and supervision necessary to install insulation to hot and cold surfaces of piping, tanks, ductwork, fittings and other surfaces.
- B. Insulation shall include insulating materials, jackets, adhesive, mastic coatings, tie wire and other materials as required to complete the insulating work.

1.2 CODES AND STANDARDS

- A. Insulating materials, jackets and mastics shall meet flame spread, fuel contribution and smoke developed ratings in accordance with NFPA-90A. Flame spread rating in accordance with NFPA 255, ASTM E-84 or UL 723 of not more than 25; smoke developed rating of not more than 50, unless otherwise noted in this section.
- B. Insulation that has been treated with a flame-retardant additive to meet the flame spread and smoke developed ratings shown above is not permitted.
- C. Insulation materials shall be noncorrosive to the materials they are applied to, including stress corrosion cracking of stainless steel, and shall not breed or promote fungus and bacteria.
- D. Insulation shall meet or exceed all requirements of the 2012 International Energy Conservation Code.

1.3 QUALIFICATION

- A. Insulating materials by Owens-Corning, Aracell, Pittsburgh-Corning, Knauf, Johns Manville, or approved equivalent.
- B. Mastics and adhesives as recommended by insulation manufacturer.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, flame spread and smoke development rating, k-value, density, temperature limitations, sound absorption coefficients, thickness, and furnished accessories for each mechanical system requiring insulation.

PART 2 PRODUCTS

2.1 PRODUCTS

- A. Description:
 - 1. Type A: Preformed, sectional, heavy density fiberglass insulation, suitable for operating temperatures from -20° F to +850° F. Equipped with factory-applied, all-service vapor barrier jacket constructed of white Kraft paper bonded to aluminum foil reinforced with fiberglass yarn, with pressure-sensitive, self-sealing longitudinal laps and butt strips. Thermal conductivity of 0.23 BTU-in/hr-ft²-°F @ 75° F mean temperature. Water vapor permeance of 0.02 perms. Johns Manville "Micro-Lok HP or approved equivalent.

Mean Temperature Rating (F)	Conductivity BTU in/(hr sqft F)
250	0.32 - 0.34
200	0.29 - 0.32
150	0.27 - 0.30
125	0.25 - 0.29
100	0.21 - 0.28
75	0.21 - 0.28

2. Type I: Fiberglass duct wrap, 1.5 PCF density, fabricated of inorganic glass fibers bonded with thermosetting resin with factory applied foil Skrim-Kraft facing, suitable for operating temperature up to +250 F. Thermal conductivity of 0.26 BTU-in/hr-ft²- F @ 75 F mean temperature. Water vapor permeance of 0.02 perms. Knauf Duct Wrap or engineer approved equivalent.
3. Type J: Flexible fiberglass duct liner, 1.5 PCF density, fabricated of inorganic glass fibers bonded with thermosetting resin, with mat face suitable for air velocities up to 4000 FPM and operating temperatures up to +250° F. Thermal conductivity of 0.25 BTU-in/hr-ft²-°F @ 75° F mean temperature. Knauf "Duct Liner E-M" or engineer approved equivalent.

2.2 INSULATION JACKETS

- A. 20-mil high impact PVC secured with spray contact adhesive. All PVC jacketing shall meet the 25/50 SDR. Manville "Zeston 2000" or equivalent.
- B. 6-oz/sq yd UL listed cotton canvas fabric secured with Childers CP50 lagging adhesive.
- C. Fitting and valve jackets shall be premolded PVC with joints and seams sealed with a spray contact adhesive or vapor barrier mastic. Premolded jackets shall be Manville "Zeston 2000" or approved equivalent.
- D. At wall penetrations and on exterior pipe, provide an additional jacket of 0.020 inch thick smooth finish aluminum. Metal jacket shall have factory applied moisture barrier. Fitting and valve covers to be preformed of same material as adjacent metal jacket
- E. Where PVC or metal jackets are used, delete the factory applied ASJ on pipe and equipment operating above 75° F.
- F. PVC jackets shall be used in the following areas and systems:
 1. Whenever piping is routed exposed through occupied spaces.
 2. Exposed piping in kitchens and dishwasher rooms.
 3. Premolded PVC at all fittings and valve jackets.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

- A. Use only experienced applicators regularly engaged in the trade. Rough work will be rejected. Application details shall be in accordance with the insulation materials supplier's recommendations, except where a higher standard is specified.
- B. Install materials after systems have been tested and approved. Material such as rust, scale, dirt and moisture shall be removed from surfaces to be insulated.

- C. Insulation shall be kept clean and dry at all times.
- D. Where pipes and ducts pass through fire rated walls, floors and partitions, a fire seal shall be provided.
- E. When flexible cellular insulation is used, it shall be installed with seams and joints sealed with contact adhesive.
 - 1. Wherever possible, the insulation shall be placed over the pipe before it is installed. Seal the butt joints with Armacell Armaflex 520, or Armaflex 520 BLV Low-VOC Contact Adhesive or equal.
 - 2. Where the insulation cannot be slipped on, cut the insulation longitudinally and apply it to the piping. Seal longitudinal seam and butt joints with Armacell Armaflex 520 adhesive, or Armaflex 520 BLV Low-VOC Contact Adhesive or equal. In all cases, the insulation, equal to Armacell AP, protected with half-round PVC sleeves the length of three times the nominal pipe size, minimum length to be 8 inches.

3.2 PIPE INSULATION INSTALLATION

- A. Insulate fittings, valves, unions, flanges, strainers, flexible connections and expansion joints with premolded or mitered segments of same insulating material as for adjacent pipe covering.
- B. Pipe insulation shall continue through sleeves and hangers with vapor barrier and/or jacket.
- C. Insert to be between support shield and piping but under the finish jacket. Provide an insert at hangars not less than 6 inches long, of same thickness and contour as adjoining insulation, to prevent insulation from sagging at support points. Inserts shall be heavy density insulating material suitable for the planned temperature range. Factory fabricated inserts may be used.
- D. Neatly finish insulation at supports, protrusions and interruptions.
 - 1. On hot systems where fittings are to be left exposed, insulation ends shall be beveled away from bolts for easy access.
 - 2. On cold systems, valve stems shall be sealed with caulking which allows free movement of the stem but provides a seal against moisture incursion.
- E. Wherever piping penetrates a floor or is exposed in a finished area, furnish a floor pipe escutcheon and/or PVC (white) jacket to protect insulation and allow for a smooth finish for cleaning.

3.3 EQUIPMENT INSULATION

- A. Do not insulate factory-insulated equipment.
- B. Apply insulation as close as possible to equipment by grooving, scoring and beveling insulation, if necessary. Secure insulation to equipment with studs, pins, clips, adhesive, wires or bands.
- C. Fill joints, cracks, seams and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- D. Cover insulation with metal mesh and finish with ¼" coat of insulating cement applied in two 1/8" layers, if non-faced insulation is used.
- E. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.
- F. When equipment with insulation requires periodical opening for maintenance, repair or cleaning such as at manway covers or strainer plugs, install insulation in such a manner that it can be easily removed and replaced without damage. Removable insulation shall have a vapor-proof cover fabricated so as to allow it to be resealed to the equipment vapor barrier.

- G. Joints shall be sealed with 2" wide vapor barrier tape or strips to match insulation jacket, using a fire-resistive adhesive.

3.4 DUCT COVERING APPLICATION

- A. Covering shall be cut slightly longer than circumference of duct to ensure full thickness at corners. Insulation shall be applied with edges tightly banded and shall be adhered to duct with fire-resistant adhesive. Adhesive shall be applied so that insulation conforms to duct surfaces uniformly and firmly.
- B. In addition to the adhesive, the insulation shall be additionally secured to the bottom of ducts 18" or wider by means of adhesive pins and speed clips. The protruding ends of the pins shall be cut off flush after the speed clips have been applied. The vapor barrier facing shall be thoroughly sealed with a vapor barrier mastic and tape where the pins have pierced through. The vapor barrier shall be continuous to prevent condensation. Insulation shall not be compressed at any location so as to reduce insulating characteristics.
- C. Joints shall be sealed with 2" wide pressure-sensitive tape or vapor barrier tape or strips, using a fire-resistive adhesive. Cuts or tears shall be sealed with strips of vapor barrier jacket applied with adhesive or pressure-sensitive tape.

3.5 PIPE INSULATION SCHEDULE (BASED ON 2012 IECC)

SERVICE	TYPE	NOMINAL PIPE SIZE (INCHES)		
		<1	1 TO <1-1/2	1-1/2 TO <4
Geothermal Water	A	1-1/2"	1-1/2"	2"
Coil Condensation Drain Piping	A	1-1/2"	1-1/2"	1-1/2"

3.6 EQUIPMENT INSULATION SCHEDULE

SERVICE	TYPE	THICKNESS
Air Separators < 28" Diameter	A	1-1/2"
Pipe Anchors / Guides	B	

3.7 MINIMUM DUCT INSULATION SCHEDULE (BASED ON 2012 IECC)

SERVICE	TYPE	THICKNESS
Outdoor Air Ducts	I	2"
Supply Air Ducts	I	2"
Return Ducts Within 20'-0" of Return Fan	J	1"
Exhaust Ducts Exposed to Outside Air, in Equipment rooms and for 10'-0" Beyond Mechanical Room Walls	I	1-1/2"

END OF SECTION 23 0700

**SECTION 23 0900
INSTRUMENTATION AND CONTROL FOR HVAC**

PART 1 GENERAL

1.1 SUMMARY

- A. Provide materials, labor, and supervision necessary to furnish and install a Direct Digital Control (DDC) system. The DDC system herein specified shall be fully integrated and installed as a complete package by the Direct Digital Control Manufacturer (Woodman Controls). The system shall include all computer software and hardware, operator input/output devices, automation sensors and controls, wiring, piping, installation, supervision and labor, calibration, adjustments and check out necessary for a complete and fully operational system.

1.2 QUALIFICATIONS

- A. All work is to be installed by a qualified person skilled in the installation of electronic automatic control systems. The control contractor is responsible for the proper installation of the control system.
1. The Installer shall have an established working relationship with the Control System Manufacturer of not less than three years.
 2. The installer shall have a service office within 50 miles of the project site and provide 24-hour response in the event of a customer call.
- B. The contractor may elect to subcontract the installation of the electronic control system but will be responsible in total as outlined above.
- C. All products used in this installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of 2 years. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner's representative in writing prior to bid date. Spare parts shall be available for at least 10 years after completion of this contract. List below only products, construction, and equipment that the reader might expect to find in this Section but are specified elsewhere.

1.3 WORK BY OTHERS

- A. The following incidental work shall be furnished by the Mechanical Contractor under the supervision of this Contractor.
1. Install automatic valves and separable wells.
 2. Furnish and install all necessary valves, pressure taps, flow meters, water, drain and overflow connections and piping.
 3. Furnish and install all necessary piping connections required for flow devices, valve position indicators, etc.
 4. Install all automatic dampers and minimum outdoor air stations, airflow stations.
 5. Provide necessary blank off plates (safing) required to install dampers that are smaller than duct size.
 6. Assemble multiple section dampers with required interconnecting linkages and extend required number of shafts through duct for external mounting of damper motors.

7. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation and affix and seal permanently in place only after stratification problem has been eliminated.
8. Provide access door or other approved means of access through ducts for service to control equipment.

1.4 DESCRIPTION

- A. Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of mechanical systems on this project.
- B. The control system shall accommodate simultaneous multiple user operation. Access to the control system data should be limited only by operator password. Multiple users shall have access to all valid system data. An operator shall be able to log onto any workstation on the control system and have access to all appropriate data.
- C. The control system shall be designed such that each mechanical system will be able to operate under stand-alone control. As such, in the event of a network communication failure, or the loss of any other controller, the control system shall continue to independently operate under control.
- D. Communication between the control panels and all workstations shall be over a high-speed network. All nodes on this network shall be peers. The operator shall not have to know the panel identifier or location to view or control an object. Application Specific Controllers shall be constantly scanned by the network controllers to update point information and alarm information.
- E. The documentation is schematic in nature. The Contractor shall provide hardware and software necessary to implement the functions and sequences shown.

1.5 SUBMITTALS

- A. Qualification of Guaranteed Unit Pricing
 1. A list of pricing criteria for components that include remote control units, foundation modules, input/output modules, expansion modules, stand alone controller, modems, damper actuators, valves, valve actuators, sensors, transmitters, controllers, relays, EP switches, PE switches, accessories, thermostats, standard software, special software, and any other items necessary for future expansion of the system.
 2. Include an hourly rate labor cost for 24-hour on call service technicians.
 3. It is desired to obtain a guarantee on the pricing criteria (including any multiplier) for a period of five (5) years not to exceed cost of living index. The submittal must indicate the guaranteed prices and be signed by an officer of the control company.
 4. The pricing criteria list shall be submitted to the Owner for review and approval upon request.
 5. A submittal of the owner training program will be required for review and approval by the Owner.
 6. An Owner approved guaranteed unit pricing submittal is required upon request.
 7. Preliminary wiring/communications hierarchy indicating communication levels between devices containing microprocessors.

- B. Contractor shall provide shop drawings and manufacturers' standard specification data sheets on all hardware and software to be provided. No work may begin on any segment of this project until submittals have been reviewed by the Engineer and Owner for conformity with the plan and specifications. All shop drawings shall be done on AutoCAD and provided to the Engineer for review and to the Owner on electronic media.
- C. Quantities of items submitted shall be reviewed by the Engineer and Owner. Such review shall not relieve the contractor from furnishing quantities required for completion.
- D. Provide the Engineer and Owner, any additional information or data which is deemed necessary to determine compliance with these specifications or which is deemed valuable in documenting the system to be installed.
- E. Submit the following within 30 days of contract award:
 - 1. A complete bill of materials of equipment to be used indicating quantity, manufacturer and model number.
 - 2. A schedule of all control valves including the valve size, model number (including pattern and connections), flow, CV, pressure rating, and location.
 - 3. Provide manufacturers cut sheets for major system components. 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 drawings shall clearly reference the specification and/or drawing that the submittal is being submitted to cover. Include:
 - a. Building Controllers, Custom Application Controllers, and Application Specific Controllers
 - b. Operator Interface Computer
 - c. Auxiliary Control Devices
 - d. Proposed control system riser diagram showing system configuration, device locations, addresses, and cabling.
 - e. Detailed termination drawings showing all required field and factory terminations. Terminal numbers shall be clearly labeled.
 - f. Points list showing all system objects, and the proposed English language object names.
 - g. Sequence of operations for each system under control. This sequence shall be specific for the use of the Control System being provided for this project.
 - h. Color prints of proposed graphics with a list of points for display.
- F. Project Record Documents: Upon completion of installation submit five (5) copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and include:
 - 1. Project Record Drawings - These shall be as-built versions of the submittal shop drawings. One set of magnetic media including CAD .DWG or .DXF drawing files shall also be provided.

2. Operating and Maintenance (O & M) Manual - These shall be as-built versions of the submittal product data. In addition to that required for the submittals, the O & M manual shall include:
 - a. Names, address and 24-hour telephone numbers of Contractors installing equipment, and the control systems and service representative of each.
 - b. Operators Manual with procedures of operating the control systems including logging on/off, alarm handling, producing point reports, trending data, overriding computer control, and changing set points and other variables.
 - c. Programming Manual with a description of the programming language including syntax, statement descriptions including algorithms and calculations used, point database creation and modification, program creation and modification, and use of the editor.
 - d. Engineering, Installation and Maintenance Manual(s) that explains how to design and install new points, panels, and other hardware; preventative maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.
 - e. A listing and documentation of all custom software created using the programming language including the point database. One set of magnetic media containing files of the software and database shall also be provided
 - f. One set of magnetic media containing files of all color-graphic screens created for the project.
 - g. A list of recommended spare parts with part numbers and supplier.
 - h. Complete original issue documentation, installation and maintenance information for all third party hardware provided including computer equipment and sensors.
 - i. Complete original issue diskettes for all software provided including operating systems, programming language, operator workstation software, and graphics software.
 - j. Licenses, Guarantee, and Warrantee documents for all equipment and systems.
 - k. Recommended preventive maintenance procedures for all system components including a schedule of tasks (inspection, cleaning, calibration, etc.), time between tasks, and task descriptions.
- G. Training Manuals: The Contractor shall provide a course outline and training manuals for all training classes at least six weeks prior to the first class. The Owner reserves the right to modify any or all of the training course outline and training materials. Review and approval by Owner and Engineer and shall be completed at least 3 weeks prior to first class.

1.6 CODES & STANDARDS

- A. Input/output devices, specified or future, associated with the DDC control system shall be ASCII (American Standard Code for Information Interchange) coded with standard EIA (Electronic Industries Association) interface hardware.

- B. Wiring performed by the DDC Contractor shall be installed in accordance with all applicable local, state, and national codes.
- C. Instrumentation hardware shall be supplied to directly interface with Instrument Society of America (ISA) Standards.
- D. Meet requirements of all applicable standards and codes, except when more detailed or stringent requirements are indicated by the Contract Documents, including requirements of this Section.
 - 1. Underwriters Laboratories: Products shall be UL-916-PAZX listed.
 - 2. National Electrical Code - NFPA 70.
 - 3. Federal Communications Commission - Part J.

1.7 WARRANTY

- A. Labor & materials for control system specified shall be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Owner. Control System failures during the warranty period shall be adjusted, repaired, or replaced at no charge or reduction in service to the Owner. The Contractor shall respond to the Owner's request for warranty service within 24 hours during customary business hours.
- B. Operator workstation software, project specific software, graphics, database, and firmware updates shall be provided to the Owner at no charge during the warranty period. Written authorization by Owner must, however, be granted prior to the installation of such changes.

1.8 OWNERSHIP OF PROPRIETARY MATERIAL

- A. All project developed hardware and software shall become the property of the Owner. These include but are not limited to: Project graphic images, Record drawings, Project database, Job-specific application programming code, All documentation.

1.9 SYSTEM PERFORMANCE

- A. Performance Standards. The system shall conform to the following:
 - 1. Graphic Display. The system shall display a graphic with a minimum of 20 dynamic points.
 - 2. Graphic Refresh. The system shall update all dynamic points with current data within 30 seconds.
 - 3. Object Command. The maximum time between the command of a binary object by the operator and the reaction by the device shall be 30 seconds. Analog objects shall start to adjust within 30 seconds.
 - 4. Object Scan. All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or workstation will be current, within the prior 60 seconds.
 - 5. Alarm Response Time. The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed 45 seconds.
 - 6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.

7. Performance. Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every 5 seconds. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
8. Multiple Alarm Annunciation. All workstations on the network shall receive alarms within 5 seconds of each other.
9. Reporting Accuracy. Table 1 lists minimum acceptable reporting accuracies for all values reported by the specified system.
 - a. TABLE I -- REPORTING ACCURACY
 - b. Reported Accuracy U.N.O
 - c. $\pm 1^{\circ}\text{F}$
 - d. $\pm 2^{\circ}\text{F}$
 - e. $\pm 2^{\circ}\text{F}$
 - f. $\pm 1^{\circ}\text{F}$
 - g. $\pm 0.25^{\circ}\text{F}$
 - h. $\pm 5\% \text{ RH}$
 - i. $\pm 5\%$ of full scale
 - j. $\pm 10\%$ of reading *Note 1
 - k. $\pm 5\%$ of reading
 - l. $\pm 0.1"$ W.G.
 - m. $\pm 2\%$ of full scale *Note 2
 - n. 5% of reading
 - o. $\pm 20 \text{ PPM}$
 - p. Note 1: 10%-100% of scale
 - q. Note 2: for both absolute and differential pressure

PART 2 PRODUCTS

2.1 OPERATOR INTERFACE

- A. Furnish a full graphics system to interface with the owners existing PC "operator workstation". The system shall include all software and hardware necessary to provide full graphics at the location of the existing operator workstation. Verify the available PC system data and furnish additional hardware to meet the requirements of this section.
- B. All alarms shall print out on the owner's existing printer.

2.2 SUPERVISED TRAINING

- A. Provide five (5) working days (40 hours) of supervised training for the Owners representatives simultaneously to include system operation, programming, report generation, and construction of graphics. Training shall take place at the project site during the normal work hours of 8am to 5pm weekdays. Training shall include:
 - 1. Explanation of drawings, operations and maintenance manuals.
 - 2. Walk-through of the job to locate control components.
 - 3. Operator workstation and peripherals.
 - 4. DDC custom application controllers, ASC, TEC, SAC operation and function.
 - 5. Operator control functions including graphic generation and field panel programming.
 - 6. Explanation of adjustment, calibration and replacement procedures.
- B. Provide operator orientation to the overall operational program, equipment functions (both individually and as part of the total integrated system), commands, advisories, and appropriate operator intervention required in responding to the systems operation. An Owner's manual prepared for this project by the DDC manufacturer shall be used in addition to the instruction. Five copies of the Owner's manual shall be provided.
- C. The technical training will also include adequate instruction and documentation to enable maintenance staff to trouble shoot, repair, and maintain entire system and recreate all programming without factory assistance.
- D. The technical training will also include adequate instruction and documentation to allow expansion by the maintenance staff of the system in the future to interface with existing pneumatic, electric, and electronic control systems. This would include activities associated with hardware and software.

2.3 COMMISSIONING OF SYSTEM

- A. The Temperature Control Contractor shall verify that each analog and binary device and operator responds correctly to the signal given at the control panel by physically changing each parameter and witnessing the correct corresponding reaction. The results of this testing shall be logged in a written report and submitted to the Owner and Engineer prior to final payment.
- B. The Owner's representative shall witness the commissioning of the system.

2.4 SYSTEM SOFTWARE

- A. Operating System. Furnish a commercially available, concurrent multi-tasking operating system. The operating system shall also support the use of other common software applications that operate under Microsoft Windows. Examples include Lotus 123, Microsoft Excel, Word Perfect, and Paradox. Acceptable operating systems are Windows NT, Windows 95 (or later version), Unix, and OS/2.

- B. System Graphics. The Operator Workstation software shall be graphically oriented. The system shall allow display of up to 10 graphic screens at once for comparison and monitoring of system status. Provide a method for the operator to easily move between graphic displays and change the size and location of graphic displays on the screen. The system graphics shall be able to be modified while on line. An operator with the proper password level shall be able to add, delete, or change dynamic points on a graphic. Dynamic points shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall have the ability to show animation by shifting image files based on the status of the point.
1. Custom Graphics. Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall be a graphically based system that uses the mouse to create and modify graphics that are saved in industry standard formats such as PCX, TIFF, and GEM. The graphics generation package shall also provide the capability of capturing or converting graphics from other programs such as Designer, or AutoCAD.
 2. Graphics Library. Furnish a complete library of standard HVAC equipment such as chillers, boilers, air handlers, terminals, unit heaters, fan coils, and unit ventilators. This library shall also include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program. All individual pieces of equipment shall be graphically represented with input and output values (both binary and analog).
 3. Engineering Units. Allow for selection of the desired engineering units in the system. Unit selection shall be able to be customized by locality to select the desired units for each measurement. Engineering units on this project shall be Standard Inch Pound.

2.5 SYSTEM APPLICATIONS

- A. Each workstation shall provide operator interface and off-line storage of system information. Provide the following applications at each workstation.
1. Automatic System Database Save and Restore. Each workstation shall store on the hard disk a copy of the current database of each building controller. This database shall be updated whenever a change is made in any panel in the system. The storage of this data shall be automatic and not require operator intervention. In the event of a database loss in a building management panel, the first workstation to detect the loss shall automatically restore the database for that panel.
 2. Manual Database Save and Restore. A system operator with the proper password clearance shall be able to archive the database from any system panel and store on magnetic media. The operator shall also be able to clear a panel database and manually initiate a download of a specified database to any panel in the system.
 3. System Configuration. The workstation software shall provide a graphical method of configuring the system. The user with proper security shall be able to add new devices, assign modems to devices, and obtain a visual riser diagram of the system. This shall allow for future system changes or additions.
 4. On-Line Help. Provide a context sensitive, on line help system to assist the operator in operation and editing of 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 a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system supervisor shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operator's access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto logoff time shall be set per operator password. All system security data shall be stored in an encrypted format.
6. Alarm Processing. Any object in the system shall be configurable to alarm in and out of normal state. The operator shall be able to configure the alarm limits, warning limits, states, and reactions for each object in the system.
 - a. Alarm Reactions. The operator shall be able to determine what actions, if any, are to be taken, by object (or point), during an alarm. Actions shall include logging, printing, starting programs, displaying messages, dialing out to remote stations, paging, providing audible annunciation or displaying specific system graphics. Each of these actions shall be configurable by workstation and time of day. An object in alarm that has not been acknowledged within an operator specified time period shall be re-routed to an alternate operator specified alarm receipt device.
 - b. Binary Alarms. Each binary object shall be set to alarm based on the operator specified state. Provide the capability to disable alarming when the associated equipment is turned off or is being serviced.
 - c. Analog Alarms. Each analog object shall have both high and low alarm limits and warning limits. Alarming must be able to be automatically and manually disabled.
7. Trend Logs. The operator shall be able to define a custom trend log for any data in the system. This definition shall include interval, start-time, and stop-time. Trend intervals of 1, 5, 15, 30, and 60 minutes as well as once a shift (8 hours), once a day, once a week, and once a month shall be selectable. All trends shall start based on the hour. Each trend shall accommodate up to 64 system objects. The system operator with proper password shall be able to determine how many samples are stored in each trend. Trend data shall be sampled and stored on the Building Controller panel and be archived on the hard disk. Trend data shall be able to be viewed and printed from the operator interface software. They shall also be storable in a tab delimited ASCII format for use by other industry standard word processing and spreadsheet packages.
8. Alarm and Event Log. The operator shall be able to view all logged system alarms and events from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and clear alarms. All that have not been cleared by the operator shall be archived to the hard disk on the workstation.
9. Object and Property Status and Control. Provide a method for the operator with proper password protection to view, and edit if applicable, the status of any object and property in the system. These statuses shall be available by menu, on graphics, or through custom programs.
10. Clock Synchronization. The real time clocks in all building control panels and workstations shall be synchronized on command of an operator. The system shall also be able to automatically synchronize all system clocks, daily from any operator designated device in the system. The system shall automatically adjust for daylight savings and standard time if applicable.

11. Reports and Logs. Provide a reporting package that allows the operator to select, modify, or create reports. Each report shall be definable as to data content, format, interval, and date. Report data shall be archived on the hard disk for historical reporting. Provide the ability for the operator to obtain real time logs of designated lists of objects. Reports and logs shall be stored on the PC hard disk in a format that is readily accessible by other standard software applications including spreadsheets and word processing. Reports and logs shall be readily printed to the system printer.
 - a. Custom Reports: Provide the capability for the operator to easily define any system data into a daily, weekly, monthly, or annual report. These reports shall be time and date stamped and shall contain a report title and the name of the facility.
 - b. Standard Reports. The following standard system reports shall be provided for this project. These reports shall be readily customized to the project by the owner.
 - 1) Electrical Meter Report: Provide a monthly report showing the daily electrical consumption and peak electrical demand for each building meter. Provide an annual (12 month) summary report showing the monthly electrical consumption and peak demand for each meter.
 - 2) Gas Meter Report: Provide a monthly report showing the daily natural gas consumption for each meter. Provide an annual (12 month) report that shows the monthly consumption for each meter.
 - 3) Weather Data Report: Provide a monthly report showing the daily minimum, maximum and average outdoor air temperature and the number of heating and cooling degree days for each day. Provide an annual (12 month) report showing the minimum, maximum and average outdoor air temperature for the month and the number of heating and cooling degree days for the month.
 - 4) Tenant Override Reports: Provide a monthly report showing the daily total time in hours that each tenant has requested after hours HVAC and lighting services. Provide an annual summary report that shows the override usage on a monthly basis.
- B. Workstation Applications Editors. Each PC workstation shall support full screen editing of all system applications. Provide editors for each application at the PC workstation. The applications shall be downloaded and executed at the appropriate controller panels.
 1. Controller. Provide a full screen editor for each type controller and application that shall allow the operator with proper password to view and change the configuration, name, control parameters, and system set-points.
 2. Scheduling. An editor for the scheduling application shall be provided at each workstation. Provide a monthly calendar for each schedule. Exception schedules and holidays shall be shown clearly on the calendar. Provide a method for allowing several related objects to follow a schedule. The advance and delay time for each object shall be adjustable from this master schedule.
 - a. An operator with proper password level shall be able to modify the schedule. Schedules shall be able to be easily copied between objects and/or dates.
 - b. Occupied/Unoccupied schedules shall be individually adjustable for each terminal unit. The user shall be able to easily change the schedule of rooms, etc. An occupied space shall automatically start the unit in normal start up mode.

3. Equipment Coordination. Provide a full screen editor that allows equipment to be grouped for proper operation as specified in the sequence of operations. This shall include the coordination of VAV boxes with their associated Air Handling Equipment.
4. Custom Application Programming. Provide the tools to create, modify, and debug custom application programming. The operator shall be able to create, edit, and download custom programs at the same time that all other system applications are operating. The system shall be fully operable while custom routines are edited, compiled, and downloaded. The programming language shall have the following features:
 - a. The language shall be English language oriented and be based on the syntax of programming languages such as BASIC. It shall allow for free form or fill in the blank programming. Alternatively, the programming language can be graphically-based using function blocks as long as blocks are available that directly provide the functions listed below, and that custom or compound function blocks can be created.
 - 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 code from the custom programming. It shall also incorporate word processing features such as cut/paste and find/replace.
 - 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 to observe any intermediate values and or results. The debugger shall also provide error messages for syntax and execution errors.
 - 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: +, -, /, x, square root, and xy. The following mathematical functions shall also be provided: natural log, log, absolute value, and minimum/maximum value from a list of values.
 - g. The programming language shall have pre-defined variables that represent clock time, day of the week, and date. Variables that provide interval timing shall also be available. The language shall allow for computations using these values.
 - h. The programming language shall have ability to pre-defined variables representing the status and results of the System Software, and shall be able to enable, disable, and change the values of objects in the system.

2.6 POWER FAIL RESTART

- A. In the event of the loss of normal power, there shall be an orderly shutdown of the digital panels and workstation to prevent the loss of data base or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data, and battery backup shall be provided to support the clock and all volatile memory for a minimum of 72 hours.
- B. Upon restoration of normal power, the panels shall automatically resume full operation without manual intervention.
- C. Should Digital panel memory be lost for any reason, the user shall have the capability of reloading the panel via the local RS-232 port, or telephone line dial-in.

2.7 SYSTEM SOFTWARE

- A. Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the operator workstation.
- B. System Security
 - 1. User access shall be secured using individual security passwords and user names.
 - 2. Passwords shall restrict the user to only the objects, applications, and system functions as assigned by the system manager.
 - 3. User logon/logoff attempts shall be recorded.
 - 4. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.
- C. Scheduling. Provide the capability to schedule each object or group of objects in the system. Each of these schedules shall include the capability for start, stop, optimal start, optimal stop, nightsetback, and economizer actions. Each schedule may consist of up to 10 events. When a group of objects are scheduled together, provide the capability to define advances and delays for each member. Each schedule shall consist of the following:
 - 1. Weekly Schedule. Provide separate schedules for each day of the week. Provide separate scheduling that is easily edited by the operator to define the occupied hours
- D. Alarm Reporting. The operator shall be able to determine the action to be taken in the event of an alarm. Alarms shall be routed to the appropriate workstations based on time and other conditions. An alarm shall be able to start programs, be logged in the event log, printed, generate custom messages and display graphics.
- E. Remote Communications. The system shall have the ability to dial out in the event of an alarm. Receivers shall include PC Workstations and text messages to cell phones. The alarm message shall include the name of the calling location, the device that generated the alarm, and the alarm message itself. The operator shall be able to remotely access and operate the system using dial up communications.
- F. Maintenance Management. The system shall monitor equipment status and generate maintenance messages based upon user designated run time, starts, and/or calendar date limits.
- G. PID Control. A PID (proportional-integral-derivative) algorithm with direct or reverse action and anti-wind-up shall be supplied. The algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs. The controlled variable, set-point, and PID gains shall be user-selectable. The set-point shall optionally be chosen to be a reset schedule.

- H. Anti-Short Cycling. All binary output points shall be protected from short cycling. This feature shall allow minimum on-time and off-time to be selected as noted above for the chillers.

2.8 BUILDING CONTROLLERS

- A. General. Provide Building Controllers to provide the performance specified in this section. Each of these panels shall meet the following requirements.
1. The Building Automation System shall be composed of one or more independent, stand-alone, microprocessor based Building Controllers to manage the global strategies described in System software section.
 2. The Building Controller shall have sufficient memory to support its operating system, database, and programming requirements.
 3. The controller shall provide a communications port for connection of a Portable Operators Terminal.
 4. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
 5. Data shall be shared between networked Building Controllers.
 6. The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
 - a. Assume a predetermined failure mode.
 - b. Generate an alarm notification.
- B. Environment. Controller hardware shall be suitable for the anticipated ambient conditions. Controller used in conditioned ambient shall be mounted in an enclosure, and shall be rated for operation at 32 F to 120 F.
- C. Serviceability. Provide diagnostic LEDs for power, communications, and processor. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.
- D. Memory. The Building Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
- E. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80% nominal voltage.

2.9 CUSTOM APPLICATION CONTROLLERS

- A. General. Provide Custom Application Controllers to provide the performance specified in this specification. Each of these panels shall meet the following requirements.
1. The Building Automation System shall be composed of one or more independent, stand-alone, microprocessor based Building Controllers to manage the local strategies described in System software section.
 2. The Controller shall have sufficient memory to support its operating system, database, and programming requirements.
 3. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
 4. Data shall be shared between networked Controllers.

5. The Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
 - a. Assume a predetermined failure mode.
 - b. Generate an alarm notification.
- B. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.
 1. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA Type 4 waterproof enclosures, and shall be rated for operation at -40° F to 150° F.
 2. Controllers used in conditioned ambient shall be mounted in dust-proof enclosures, and shall be rated for operation at 32° F to 120° F.
- C. Serviceability. Provide diagnostic LEDs for power, communications, and processor. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.
- D. Memory. The Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
- E. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80% nominal voltage.

2.10 APPLICATION SPECIFIC CONTROLLERS

- A. General. Application specific controllers (ASC) are microprocessor-based DDC controllers which through hardware or firmware design are dedicated to control a specific piece of equipment. They are not fully user programmable but are customized for operation within the confines of the equipment they are designed to serve.
 1. Each ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.
 2. Each ASC will contain sufficient I/O capacity to control the target system.
- B. Environment. The hardware shall be suitable for the anticipated ambient conditions.
 1. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA Type 4 waterproof enclosures, and shall be rated for operation at -40° F to 150° F.
 2. Controller used in conditioned ambient shall be mounted in dust-proof enclosures, and shall be rated for operation at 32° F to 120° F.
- C. Serviceability. Provide diagnostic LEDs for power, and communications. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.
- D. Memory. The Application Specific Controller shall maintain all BIOS and programming information in the event of a power loss for at least 90 days.
- E. Immunity to Power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80%.
- F. Transformer. Power supply for the ASC must be rated at minimum of 125% of ASC power consumption and shall be fused or current limiting type.

2.11 COMMUNICATIONS

- A. The controls Contractor shall provide all communication media, connectors, repeaters, hubs, and routers necessary for the inter-network.

- B. All Building Controllers shall have a communications port for connections with the operator interfaces.
- C. Communications services over the inter-network shall result in operator interface and value passing that is transparent to the inter-network architecture as follows:
 - 1. Connection of an operator interface device to any one controller on the inter-network will allow the operator to interface with all other controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all controllers shall be available for viewing and editing from any one controller on the inter-network.
 - 2. All database values (i.e. points, software variable, custom program variables) of any one controller shall be readable by any other controller on the inter-network. This value passing shall be automatically performed by a controller when a reference to a point name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communications services to perform inter-network value passing.
- D. The time clocks in all controllers shall be automatically synchronized daily.

2.12 INPUT/OUTPUT INTERFACE

- A. Hard-wired inputs and outputs may tie into the system through Building, Custom, or Application Specific Controllers.
- B. All input points and output points shall be protected such that shorting of the point to itself, another point, or ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.
- C. Binary inputs shall allow the monitoring of on/off signals or from remote devices. The binary inputs shall provide a wetting current of at least 12 ma to be compatible with commonly available control devices.
- D. Pulse accumulation input points. This type of point shall conform to all the requirements of Binary Input points, and also accept up to 2 pulses per second for pulse accumulation, and shall be protected against effects of contact bounce and noise.
- E. Analog inputs shall allow the monitoring of low voltage (0-10 Vdc), current (4-20 ma), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.
- F. Binary outputs shall provide for on/off operation, or a pulsed low voltage signal for pulse width modulation control. Outputs shall be selectable for either normally open or normally closed operation.
- G. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0-10 Vdc or a 4-20 ma signal as required to provide proper control of the output device.

2.13 AUXILIARY CONTROL DEVICES

- A. Electronic damper/valve actuators.
 - 1. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator. Furnish a separate damper actuator for each damper greater than 48" in any dimension.

2. Where shown, for power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.
 3. All rotary spring return actuators shall be capable of both clockwise and counterclockwise spring return operation. Linear actuators shall spring return to the retracted position.
 4. Proportional actuators shall accept a 0-10 VDC or 0-20 ma control signal and provide a 2-10 VDC or 4-20 ma operating range.
 5. All 24 VAC/DC actuators shall not require more than 10 VA for AC or more than 8 W for DC applications. Actuators operating on 120 VAC or 230 VAC shall not require more than 11 VA.
 6. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.
 7. All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation.
 8. Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
 9. Actuators shall be Underwriters Laboratories Standard 873 listed.
 10. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque. Actuators shall include a stroke limiting device.
- B. Automatic Dampers (low leakage)
1. Dampers shall include the frame, blades, and linkage assembly. Coordinate damper sizes and quantities with exhaust air fans, plenums, air handling units, and built up air handling units. Dampers shall be as follows:
 - a. Opposed blade configuration and suitable for operating temperatures between -40° F and 200° F.
 - b. The assembly shall include airfoil type blades with the linkage out of the airstream and concealed in the frame.
 - c. The seals shall include extruded vinyl blade edge seals and flexible metal compression type jamb seals. Bearings shall be stainless steel sleeve. The axles shall be 1/2" plated steel hex.
 - d. The Damper shall be constructed of a minimum of 16 gauge galvanized steel.
 - e. Damper shall have a maximum leakage performance rating of 4 cfm per square foot at 1 inch water gauge static pressure differential (based on a 36 "wide x 24" high damper).
 - f. Dampers shall bear the AMCA certification for air leakage.
 - g. Low leakage dampers shall be by Ruskin or approved equal.
 2. Reference the drawings for minimum and economizer outdoor air damper sizes.
 3. Submit product data, performance and installation data. Clearly indicate profile of damper size, materials, damper blade configuration, damper linkage, leakage characteristics and operators.

C. Control Valves

1. Control valves shall be two-way or three-way type for two-position or modulating service as scheduled, shown, or as indicated in the sequence of operation.
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 per 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: Pressure drop shall be equal to the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or a maximum of 4 psi.
 - 3) Three-way Modulating Service: Pressure drop equal to the pressure drop through the coil exchanger (load), 4 psi maximum.
 - 4) Valves 1/2" through 2" shall be bronze body or cast brass ANSI Class 250, spring loaded, Teflon packing, quick opening for two-position service. Two-way valves to have replaceable composition disc, or stainless steel ball.
 - 5) 2-1/2" valves and larger shall be cast iron ANSI Class 125 with guided plug and Teflon packing.
4. General
 - a. Water and Steam valves shall fail normally open or closed as scheduled on plans or as follows:
 - 1) Duct mounted heating coil valves - normally closed.
 - 2) Heating coils in air handlers - normally open.
 - 3) Chilled water control valves - normally closed.
 - 4) Other applications - as scheduled or as required by sequence of operation.

D. Sensors:

1. Room and duct humidity sensors shall be of the thin film capacitance type containing a humidity sensitive material that modifies its dielectric constant to maintain accuracy of + 5% RH @ 77° F, range of 20% to 95% RH, including hysteresis, linearity, and repeatability. The sensor shall be rated for operation between 15 to 170 degrees F.

2. All temperature and humidity sensors shall be of the electronic type. The temperature sensors shall be resistance temperature device (RTD) or thermistor type.
 - a. Room sensors shall include covers for horizontal or vertical mounting and concealed adjustments. Sensors shall include adjustable slide temperature sensors, and two-hour push button override. All wall sensors located on exterior walls or surfaces that will cause abnormal sensor readings shall be furnished with an insulated base.
 - b. Room sensors shall have a range of 32-120 degrees F with a factory calibration of 74° F. Accuracy shall be plus or minus 1degree F at calibration point. Mounting height of room sensors shall be verified with owner prior to installation.
 - c. Duct Temperature Sensors - accuracy of + 1° F @ 77 deg F. Duct air sensors shall be duct single point, averaging probe or averaging bulb as required under sequence of operation.
 - d. Use insertion elements with a brass well with a minimum length of 2.5"
 - e. Outside air sensor shall have watertight inlet fitting and contain a shield from direct sunlight.
- E. Low Temperature Detection
 1. Electric low temperature warning thermostats shall have 20 ft low point sensitive elements (not averaging type) installed in parallel or series to serpentine the entire coil face area of the chilled water coil. These thermostats shall be two position reset type. Where coils are in banks, multiple low limit thermostats, wired in series, shall be provided and wired to initiate the freeze condition sequences specified and signal a remote alarm to the facilities management console.
 2. The low temperature thermostat shall be automatic reset type as described in the sequence of operations.
 3. Thermostat shall be adjustable between the temperatures of 35° to 45° F.
- F. Current Sensing Relays - shall be split core type with adjustable high and low trip settings. Range shall not exceed 175% of expected input. Coordinate special requirements for systems with variable speed drives.
- G. Flow Switches
 1. Flow-proving switches shall be either paddle or differential pressure type for proof of flow application.
 2. Paddle type switches (water service only) shall be UL listed, SPDT snap-acting with pilot duty rating (125 VA minimum). Adjustable sensitivity with NEMA Type 1 enclosure unless otherwise specified:
 3. Differential pressure type switches (air or water service) shall be UL listed, solid state, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA Type 1 enclosure, with scale range and differential suitable for intended application, or as specified. Mercoid type switches shall not be used for equipment that vibrates such as chillers, etc. Differential pressure switches shall be by Orange Research or approved equal.
 4. Current sensing relays may be used for flow sensing or terminal devices.
- H. Relays
 1. Control relays shall be UL listed plug-in type with dust cover. Contact rating, configuration, and coil voltage suitable for application.

2. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable plus or minus 200% (minimum) from set-point shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA Type 1 enclosure when not installed in local control panel.
- I. Transformers and Power Supplies
1. Control transformers shall be UL listed, Class 2 current-limiting type, or shall be furnished with over-current protection in both primary and secondary circuits for Class 2 service.
 2. Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Output ripple shall be 3.0 mV maximum Peak-to-Peak. Regulation shall be 0.10% line and load combined, with 50 microsecond response time for 50% load changes. Unit shall have built-in over-voltage protection.
 3. Unit shall operate between 0° C and 50° C.
 4. Unit shall be UL recognized.
- J. Local Control Panels
1. All indoor control cabinets shall be fully enclosed NEMA Type 1 construction with hinged door, key-lock latch, removable sub-panels. A single key shall be common to all field panels and sub-panels.
 2. Interconnections between internal and face-mounted devices pre-wired 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 termination's for field connection shall be individually identified per control drawings.
 3. Provide on/off power switch with over-current protection and main air gauge for control power sources to each local panel.
- K. Auxiliary Devices
1. Furnish and install all necessary auxiliary electronic devices as appropriate to accomplish the sequence as specified. These totally electronic devices shall include (but not be limited to) such items as load limiting controllers, low signal selectors, high signal selectors, remote reset control devices, floating alarm units, staging networks, damper position indicators, unison amplifiers, reversing networks, sequencing networks and electronic power supplies.

2.14 WIRING

- A. All electric wiring required for the control system and any interlock wiring required for the controls sequence shall be provided by the Temperature Control Contractor.
- B. All line voltage control wiring shall be run in conduit. Reference Division 16 for requirements.
- C. Wire shall be a minimum of #18 gauge, color coded, stranded wire for all low voltage, electronic circuit with "spares" installed (one for every group of 10 wires) in conduit.
- D. Coordinate the requirements for 120V circuits for the ASC's. All control transformers shall be the responsibility of this contractor. Reference the electrical drawings for circuit locations.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install wiring in a neat and workmanlike manner. Wiring to finished spaces shall be run concealed.
- B. All work is to be installed by a qualified person skilled in the installation of electronic control systems. The control company representative is responsible for the proper installation of the control system and will provide supervision of the installation.
- C. Wire the flow switches and other chiller control devices not factory wired. Reference the chiller specification.
- D. Install damper actuators for all automatic dampers.
- E. Install terminal equipment controllers on terminal boxes and provide all necessary control wiring.
- F. Install system and materials in accordance with manufacturer's instructions and roughing -in drawings, and details and drawings. Install electrical work and use electrical products complying with requirements of applicable Division 26 sections of these specifications. Mount controllers at convenient locations and heights.
- G. Wiring. The term "wiring" is defined to include providing of wire, conduit and miscellaneous materials as required for mounting and connecting electric control devices.
- H. Wiring System. Install complete wiring system for electric-electronic temperature controls. Conceal wiring, except in mechanical rooms and areas where other conduit and piping are exposed. Provide multi-conductor instrument harness (bundle) in place of single conductors where number of conductors can be run along common path. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.
- I. Number-code or color-code conductors, appropriately for future identification and servicing of control system.

3.2 ON-SITE TESTING

- A. Provide Engineer and/or Owner approved operation and acceptance testing of the complete system. The Engineer and/or Owner will witness all tests.
- B. Field Test. When installation of the system is complete, calibrate equipment and verify transmission media operation before the system is placed in line. All testing, calibrating, adjusting and final field tests shall be completed by the installer. Provide a cross-check of each control point within the system by making a comparison between the control command and the field-controlled device. Verify that all systems are operable from local controls in the specified failure mode upon panel failure or loss of power. Submit the results of functional and diagnostic tests and calibrations to the Engineer for final system acceptance.
- C. Compliance Inspection Checklist. Submit in the form requested, the following items of information to the Owner's representative and Architect/Engineer for verification of compliance to the project specifications. Failure to comply with the specified information shall constitute non-performance of the contract. The contractor shall submit written justification for each item in the checklist that he is unable to comply with. The Owner's Representative and the Architect/Engineer will initial and date the checklist to signify Contractor's compliance before acceptance of system.

1. Verify to the Owner's Representative and Architect/Engineer in letter form that supplier has in-place support facility. Letter shall show location of support facility, name and titles of technical staff, engineers, supervisors, fitters, electricians, managers and all other personnel responsible for the completion of the work on this project
 - a. User _____ Date _____ A/E _____ Date _____
2. Manually generate an alarm at the remote DDC Controller as selected by the Architect/Engineer to demonstrate the capability of the workstation and alarm printer to receive alarms within 5 seconds.
 - a. User _____ Date _____ A/E _____ Date _____
3. Disconnect one DDC Controller from the network to demonstrate that a single device failure shall not disrupt or halt peer-to-peer communication. Panel to be disconnected shall be selected by the Architect/Engineer.
 - a. User _____ Date _____ A/E _____ Date _____
4. At a DDC Controller of the Architect/Engineer's choice, display on the portable operator's terminal:
 - a. At least one temperature setpoint and at least one status condition; i.e.: on or off for a system or piece of equipment attached to the panel as well as for points at another DDC Controller on the network.
 - b. The diagnostic results as specified for a system or piece of equipment attached to that panel as well as for a system or piece of equipment attached to another DDC Controller.
 - c. The ability to add a new point to the DDC Controller with the POT and have it automatically uploaded to the workstation to modify that panel's stored database.
 - d. User _____ Date _____ A/E _____ Date _____
5. At the Architect/Engineer's choice, disconnect the trunk connection to demonstrate its lack of reliance on a DDC Controller to maintain full control functionality.
 - a. User _____ Date _____ A/E _____ Date _____

3.3 SERVICE AND GUARANTEE

- A. General Requirements. Provide all services, materials and equipment necessary for the successful operation of the entire BAS System for a period of one year after completion of successful performance test. Provide necessary material required for the work. Minimize impacts on facility operations when performing scheduled adjustments and non-scheduled work.
- B. Description of Work. The adjustment and repair of the system includes all computer equipment, software updates, transmission equipment and all sensors and control devices. Provide the manufacturer's required adjustment and all other work necessary.
- C. Personnel. Provide qualified personnel to accomplish all work promptly and satisfactorily. Owner shall be advised in writing of the name of the designated service representative, and of any changes in personnel.

- D. Schedule of Work. Provide two minor inspections at 6 month intervals and two major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude, and all work required as specified. Schedule major inspections in July and January. Minor inspections shall include visual checks and operational test of all equipment delivered. Major inspections shall include all work described for minor inspections and the following work:
 - 1. Clean all equipment, including interior and exterior surfaces.
 - 2. Perform signal, voltage and system isolation checks of system workstations and peripherals.
 - 3. Check and calibrate each field device. Check all analog points and digital points.
 - 4. Run all diagnostics and correct all previously diagnosed problems.
 - 5. Resolve and correct any previous outstanding problems.
- E. Emergency Service. Owner shall initiate service calls when the system is not functioning properly. Qualified personnel shall be available to provide service to the complete system. Furnish Owner with a telephone number where service representative can be reached at all times. Service personnel shall be at the site within 4 hours after receiving a request for service. Restore the control system to proper operating condition within 24 hours.
- F. Operation. Performance of scheduled adjustment and repair shall verify operation of the system as demonstrated by the initial performance test.
- G. Systems Modifications. Provide any recommendations for system modification in writing to Owner. Do not make any system modifications, including operating parameters and control settings, without prior approval of Owner. Any modifications made to the system shall be incorporated into the operations and maintenance manuals, and other documentation affected.
- H. Software. Provide all software updates and verify operation in the system. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and shall be incorporated into the operations and maintenance manuals, and software documentation.

3.4 EXAMINATION

- A. The project plans shall be thoroughly examined for control device and equipment locations, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

3.5 GENERAL WORKMANSHIP

- A. Install equipment, piping, wiring/conduit 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 all equipment in readily accessible location as defined by chapter 1 article 100 part A of the NEC. Control panels shall be attached to structural walls unless mounted in equipment enclosure specifically designed for that purpose. Panels shall be mounted to allow for unobstructed access for service.
- D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

- F. Coordinate with the testing and balancing contractor to adjust low leakage dampers if damper leak rate exceeds specifications.

3.6 INSTALLATION OF SENSORS

- A. Install sensors in accordance with the manufacturer's recommendations.
- B. Mount sensors rigidly and adequate for the environment within which the sensor operates.
- C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.
- D. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.
- E. Install duct static pressure tap with tube end facing directly down-stream of airflow.
- F. Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.
- G. All pipe mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat conducting fluid in thermal wells.
- H. Wiring for space sensors shall be concealed in building walls. EMT conduit is acceptable within mechanical and service rooms.
- I. Install outdoor air temperature sensors on north wall complete with sun shield at designated location.

3.7 ACTUATORS

- A. Mount and link control damper actuators per manufacturer's instructions.
- B. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
- C. Valves - Actuators shall be mounted on valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following manufacturer's recommendations.

3.8 WARNING LABELS

- A. Affix plastic labels on each starter and equipment automatically controlled through the Control System including all air handling unit fans at doors. Label shall indicate the following:
 - 1. This equipment is operating under automatic control and may start at any time without warning.

3.9 IDENTIFICATION OF HARDWARE AND WIRING

- A. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information.
- B. Permanently label or code each point of field terminal strips to show the instrument or item served.
- C. Identify control panels with minimum 1 cm letters on laminated plastic nameplates.

- D. Identify all other control components with permanent labels. Identifiers shall match record documents All plug-in components shall be labeled such that removal of the component does not remove the label.

3.10 CONTROLLERS

- A. Provide a separate Controller for each major piece of HVAC equipment. 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 a minimum of 15% spare I/O point capacity for each point type found at each location. If input points are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required. A minimum of one spare is required for each type of point used.
- C. Future use of spare capacity shall require providing the field device, field wiring, point database definition, and custom software. No additional Controller boards or point modules shall be required to implement use of these spare points.

3.11 PROGRAMMING

- A. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25% of available memory free for future use.
- B. Point Naming. System point names shall be modular in design, allowing easy operator interface without the use of a written point index.
- C. Software Programming
 - 1. Provide programming for the system as per specifications and adhere to the strategy algorithms provided. All other system programming necessary for the operation of the system but not specified in this document shall also be provided by the Control System Contractor. Imbed 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 sequence of operations.
- D. Operators' Interface
 - 1. Standard Graphics. Provide graphics for each major piece of equipment and floor plan in the building. This includes each Chiller system, Air Handlers, all VAV terminals. These standard graphics shall show all points dynamically as specified in the points list.
 - 2. The controls contractor shall provide all the labor necessary to install, initialize, start-up, and trouble-shoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface data base, and any third party software installation and integration required for successful operation of the operator interface.
 - 3. As part of this execution phase, the controls contractor will perform a complete test of the operator interface. Test duration shall be a minimum of 16 hours on-site. Tests shall be made in the presence of the Owner or Owner's representative.
- E. Demonstration. A complete demonstration and readout of the capabilities of the monitoring and control system shall be performed. The contractor shall dedicate a minimum of 4 hours on-site with the Owner and his representatives for a complete functional demonstration of all the system requirements. This demonstration constitutes a joint acceptance inspection and permits acceptance of the delivered system for on-line operation.

3.12 CLEANING

- A. This contractor shall clean up all debris resulting from his or her activities daily. The contractor shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and placed in a location designated by the Construction Manager or General Contractor.
- B. At the completion of work in any area, the Contractor shall clean all of his/her work, equipment, etc., making it free from dust, dirt and debris, etc.
- C. At the completion of work, all equipment furnished under this Section shall be checked for paint damage, and any factory finished paint that has been damaged shall be repaired to match the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.13 PROTECTION

- A. The Contractor shall protect all work and material from damage by his/her work or workers 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 his/her work against theft or damage and shall carefully store material and equipment received on site 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.

3.14 FIELD QUALITY CONTROL

- A. All work, materials and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this Section.
- B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship. All visible piping and or wiring runs shall be installed parallel to building lines and properly supported.
- C. Contractor shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

3.15 ACCEPTANCE

- A. The control systems will not be accepted as meeting the requirements of Completion until all tests described in this specification have been performed to the satisfaction of both the Engineer and Owner. 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 Owner's representative. Such tests shall then be performed as part of the warranty.

END OF SECTION

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**SECTION 23 2113
HYDRONIC PIPING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide equipment, materials, tools, labor, and supervision necessary to furnish, fabricate, and install complete piping system.

1.2 STANDARDS AND CODES

- A. Pipe materials specified in this Section shall apply to technical sections of Division 15 of the Project Manual where applicable. Special requirements as may be called for in the technical sections, or shown on the Drawings, shall take precedence over General Requirements herein. Piping located in plenums shall be plenum rated for fire and smoke.

1.3 PRODUCT HANDLING

- A. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage, and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.
- B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.
- C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1.4 SUBMITTALS

- A. Submit piping schedule listing each pipe material used and systems served.
- B. Submit Shop Drawings and Product Data which shall include product description, manufacturer, dimensions, size, rough-in requirements, finishes, connections to other equipment and piping, and performance data.

PRODUCTS

2.1 MATERIAL

- A. Pipe Material and Service
 - 1. Copper water tube, hard temper, ASTM B88:
 - a. Type K: Underground geothermal systems.
 - b. Type L: Aboveground geothermal systems.
 - 2. Black steel pipe ERW, Schedule 40, ASTM A53: geothermal systems.
- B. Fittings
 - 1. Threaded pipe - malleable iron fittings, 125-pound standard flat band water pattern.
 - 2. Welded pipe - welded neck fittings and welded neck flanges, same material and strength as pipe.

3. Grooved fittings –may be used for chilled water and heating water, as approved by Code. Grooved fittings shall be Victaulic, Grinnell, or engineer-approved equivalent.
 4. Carbon steel pipe - material and strength shall correspond to pipe specifications. ANSI B31.5.
- C. Joints
1. Threaded pipe - make joints using approved pipe joint compound, applied to male threads only. Cut pipe square, cut threads clean, remove burrs, and ream ends to full size of bore. Threads shall not be exposed on chromium-plated pipe.
 2. Threadless brass pipe - use brazing alloy which will flow freely at 1300° F, use flux and brazing method as recommended by manufacturer of brazing alloy.
 3. Copper water and drainage tube - use 95-5 tin antimony or silver solder, cut pipe square, clean and polish tube ends and inner surface of fittings, apply flux and solder joint as recommended by manufacturer of solder type fittings.
 4. Welded pipe - welding shall conform to welding section of ANSI B31.1 "Code for Power Piping". Pipe up to 2" diameter shall be screwed. Pipe 2-1/2" diameter and over shall be welded.
- D. Nipples and Unions
1. Nipples shall conform to size, weight, and strength of adjoining pipe. When length of unthreaded portion of nipple is less than 1-1/2", use extra strong nipple; do not use close nipples.
 2. For pipe 3" and smaller, use screwed unions; over 3", use flanged unions. For steel and wrought iron pipe, use malleable iron ground joint unions, black or galvanized, to conform to pipe. Cast iron flanged unions are to be gasket type. For threaded brass pipe, use bronze ground joint unions with octagon ends. Install unions on equipment intended to be disassembled.
 3. Dielectric unions shall be installed between connections of copper pipe and ferrous piping.

2.2 EXPANSION TANKS – NON-POTABLE SYSTEMS

- A. Provide expansion tanks of size and number as indicated. Construct tank of welded steel, constructed, tested, and stamped in accordance with Section VIII of ASME Boiler and Pressure Vessel Code for a working pressure of 125 psi. Furnish National Board Form U-1 denoting compliance. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles or hangers. Provide replaceable heavy-duty butyl rubber bladder to permanently separate air charge from system water and to maintain design expansion capacity. Provide pressure gauge, lifting rings, floor mounting skirt, and drain fitting.
- B. Tank bladder shall allow for full acceptance volume.

2.3 AIR SEPARATORS

- A. Air Separators: Provide air separators as indicated. Construct sizes 1-1/2" and smaller of cast iron; and sizes 2" and larger of steel, complying with ASME Boiler and Pressure Vessel Code and stamped with "U" symbol. Furnish National Board Form U-1 denoting compliance.
- B. Manufacturer: Subject to compliance with requirements, provide air separators manufactured by Amtrol, Inc., Armstrong, Bell & Gossett ITT, Fluid Handling Division, Taco, Inc., Wessels, or an engineer-approved equivalent.

2.4 AIR VENTS

- A. Manual air vents, equivalent to B & G No. 17 SR.
- B. Automatic Vent Valves: Provide automatic vent valves designed to vent automatically with float principle, stainless steel float and mechanisms, cast-iron body, pressure rated for 125 psi, minimum 3/4" NPS inlet and outlet connections. Equivalent to Bell & Gossett #7 or #87 (#107A for high capacity where noted on Drawings), with copper overflow connection.
- C. Manufacturer: Subject to compliance with requirements, provide vent valves by Bell & Gossett-ITT Fluid Handling Division, Hoffman Specialty-ITT Fluid Handling Divisions, Spirax/Sarco, Watson-McDaniel Co., or an engineer-approved equivalent.

2.5 FLOW BALANCING

- A. Calibrated Balance Valves (Ball Type) with Flow Meter Fittings:
 - 1. Provide as indicated, calibrated balance valves equipped with readout ports to facilitate connecting of differential pressure meter to balance valves. Valves shall provide precise flow measurement, precision flow balancing and positive shut-off with no drip seat. Valves shall have memory stop feature to allow valve to be closed for service and then re-opened to set point without disturbing balance position. Provide calibrated nameplate or division ring scale to indicate degree of precision-machined orifice. Valves to be leak tight at full-rated working pressure. All valves to be provided with molded insulation to permit access for balancing and readout.
 - 2. Circuit setters need not be line size but shall be sized for specific application.
 - 3. Provide balancing devices designed for low flow applications for flows 1 GPM and lower.
 - 4. Manufacturer:
 - a. Subject to compliance with requirements, provide calibrated balance valves by Armstrong, Bell & Gossett, Griswold, Taco, Inc., or an engineer-approved equivalent.
- B. Calibrated Balance Valve (Globe Type) with Flow Meter Fittings
 - 1. Provide as indicated, calibrated balance valves equipped with two metering/test ports with internal check valves and protective caps to facilitate connecting to differential pressure meter to balance valves.
 - 2. Valve shall be globe style and shall provide precise flow measurement, precision flow balancing and positive shut-off with no drip seat. Valve shall be leak tight at full rated pressure.
 - 3. Valves shall have memory stop feature to allow valve to be closed for service and then re-opened to set point without disturbing balance position. Provide calibrated nameplate or division ring scale to indicate valve position.
 - 4. Valve need not be line size but shall be sized for specific application.
 - 5. Provide balance valves designed for low flow applications for flows of 1 GPM and lower.
 - 6. Valves ½" through 2" shall be constructed of dezincification resistant brass or bronze alloy.
 - 7. Valves 2½" through 12" shall be constructed of iron with ANSI Class 125/150 flanged or grooved ends.
 - 8. Manufacturer: Subject to compliance with requirements, provide calibrated balance valves by Nibco, Armstrong, Grinnell or an engineer-approved equivalent.

C. Automatic Flow Control Valves

1. Where indicated on drawings, provide automatic flow control valves with internal adjustment capability.
2. All internally adjustable cartridges shall include only non-abrasive and non-corrosive thermoplastic materials, whose shape and properties will not change over the life of the valve.
3. The cartridge shall be removable, without removing the valve or disturbing the line plumbing in any way, by unscrewing a plug in the valve body. The cartridge shall remain attached to the inside of the removed plug, to ensure it does not get misplaced and the plug is not re-installed without the cartridge.
4. Each cartridge shall be field adjustable to any of 8 flow rates with an Allen wrench.
5. Valves shall be warranted, by the manufacturer, to be free of defects in material and workmanship for a period of 5 years.
6. Valves shall control flow to within $\pm 5\%$ of design.
7. The valve flow curve shall be smooth over its entire nominal control range. Gaps, bumps and dips in flow curves shall not be acceptable.

D. Flow Meter:

1. Provide the user with one portable differential flow meter with carrying case, equivalent to Bell & Gossett No. RO-2 for use with the flow meter fittings.

2.6 VENTURI TYPE FLOW METER FITTING

- A. General: Provide as indicated, Venturi type flow meter equipped with readout valves to facilitate connecting of differential pressure meter to flow meter. Pressure drop through the Venturi shall not exceed 2 feet w.g. Equip each readout valve with integral EPT check valve designed to minimize system fluid loss during monitoring process. Provide calibrated nameplate with flow meter detailing its flow range through range of differential head pressures. Venturi should be sized to produce gauge reading in the center of scale during design flow.
- B. Furnish permanently wall-mounted, 6" round dial, 270° indication remotely mounted at or about 60" above finished floor. Accuracy of the meter shall be no less than .5% full scale. Furnish with bleed-off and shut-off valves. Furnish permanently mounted meter and locate where directed by Owner.
- C. Manufacturer: Subject to compliance with requirements, provide Venturi flow meter fittings manufactured by Aeroquip, Barco, Presco, Gerand, or an engineer-approved equivalent.

2.7 TEMPERATURE AND PRESSURE GAUGE CONNECTOR TAPS

- A. Provide temperature gauge connector taps pressure rated for 500 psi and 200° F (90° C). Construct of brass and finish in nickel-plate, equip with 1/2" NPS fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8" O.D. probe assembly for dial type insertion thermometer. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness, for insulated piping.
- B. Provide one test kit.
- C. Manufacturer: Subject to compliance with requirements, provide gauge connector taps manufactured by Peterson Engineering Co., Sisco, Trerice, or an engineer-approved equivalent.

2.8 FLEXIBLE CONNECTORS

- A. Flexible connectors through 4 in. size shall be fabricated of a corrugated bronze inner tube with a braided wire stainless steel outer jacket. Tubes to be welded to pipe ends, threaded through 2 in. size, flanged for sizes 2-1/2 in. through 4 inches.
- B. Flexible connectors for pipe sizes larger than 4" shall be fabricated of nylon reinforced rubber with ductile iron flanges and control rods to limit travel.

2.9 LOW PRESSURE Y-TYPE PIPELINE STRAINERS

- A. General: Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 125 psi working pressure, with Type 304 stainless steel screens.
- B. Threaded Ends 2" and Smaller: Cast-iron body, screwed screen retainer with centered blow-down fitted valve for blow-down.
- C. Copper Piping 2" and Smaller: Use cast bronze strainer equal to Mueller #351 with blow-down valve and cap.
- D. Threaded End 2-1/2" and Larger: Cast-iron body, bolted screen retainer with off-center blow-down fitted with valve for blow-down. Fitted with 3/64 perforated screen.
- E. Flanged Ends 1-1/2" and Larger: Cast-iron body, bolted screen retainer with off-center blow-down fitted with valve for blow-down. Fitted with 3/64 perforated screen.
- F. Provide blow-down valve and cap or plug for each strainer.
- G. Manufacturer: Subject to compliance with requirements, provide Y-type strainers manufactured by, Armstrong, Hoffman Specialty, Metraflex, Mueller, Spirax/Sarco, Trane, Watts Regulator, or an engineer-approved equivalent.

2.10 SLEEVES

- A. Sleeves passing through non-load bearing walls and partitions shall be galvanized sheet steel with lock seam joints of minimum gauges as follows: For pipes 2-1/2" in size and smaller - 24-gauge; 3 in. to 6 in. - 22-gauge; over 6 in. - 20-gauge.
- B. Sleeves passing through load bearing walls, concrete beams, fireproof walls, foundations, footings, and waterproof floors shall be Schedule 40 galvanized steel pipe or cast iron pipe.
- C. Sleeves for insulated piping shall be of sufficient internal diameter to take pipe and insulation and to allow for free movement of pipe. Waterproof sleeves shall be of sufficient internal diameter to take pipe and waterproofing material.
- D. In finished areas where pipes are exposed, sleeves shall be terminated flush with wall, partitions and ceilings, and shall extend 1/2 in. above finished floors. Extend sleeves 1 in. above finished floors in areas likely to entrap water and fill space between sleeves and pipe with graphite packing and caulking compound.
- E. Sleeves passing through membrane waterproofing or roofing shall be flashed and sealed.

2.11 GLYCOL FEEDER

- A. The glycol feed system shall include a tank, controller with integral pump and accessories required for a fully operational feed system. The unit shall be provided with a single point power connection. Furnish assembly with audible alarm, silence switch, and auxiliary alarm contact for monitoring by the building automation system. Each system shall be filled complete with the appropriate amount of glycol solution that system is indicated to contain. Glycol feeder shall be by Neptune or approved equivalent.

B. Tank:

1. Each feed system shall include a 50-gallon polyethylene tank with 1/3 hinge cover that is fully supported by the bottom mount stand.

C. Control Panel:

1. A control panel shall be mounted on the tank structure and shall include a NEMA 4X box. Provide panel with three position hand-off auto switch. When in the automatic position, the unit shall operate in response to a loss in pressure in the hydronic system that it serves. The controls shall include all safeties as required to alarm upon low levels and as required to protect the operation of the pump.

D. Pump:

1. Furnish 1/3 horsepower gear pump to provide a 1.5 gpm flow against pressures up to 90 psig. Discharge tubing shall include PVC drain valve, flexible tubing, cast iron Y-strainer, ball valve, brass check valve, and pressures gauges.

E. Electrical:

1. Furnish with fuses, main power switch, low level indicator lights, green main power light and green pumping light (on during operation only). Furnish auxiliary contact for pump operation.

2.12 PIPE ESCUTCHEONS

- A. Provide pipe escutcheons with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extensions, if any. Furnish pipe escutcheons with chrome finish for occupied areas, prime paint finish for unoccupied areas.
- B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.
- C. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.
- D. Manufacturer: Chicago Specialty; Producers Specialty; or Sanitary-Dash.

2.13 GUARDS

- A. Where exposed insulated piping extends through floor, provide sheet metal guard around insulation to extend up from floor 60 inches. Guard to be galvanized sheet steel not less than 26-gauge.

2.14 MECHANICAL SLEEVE SEALS

- A. Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
- B. Manufacturer: Garlock, Model: Link-Seal

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install pipe for mechanical systems as shown on the Drawings, as called for in other Sections, and as specified herein.
- B. Arrange and install piping approximately as indicated, straight, plumb, and as direct as possible, form right angles on parallel lines with building walls. Keep pipes close to walls, partitions, and ceilings, offsetting only where necessary to follow walls and avoid interference with other mechanical items. Locate groups of pipes parallel to each other; space at a distance to permit applying full insulation and to permit access for servicing valves. Piping to be run in concealed locations unless indicated exposed, or in equipment rooms.
- C. Install horizontal piping as high as possible without sags or humps so that proper grades can be maintained for drainage. Branch piping shall come off the tops of mains unless shown otherwise.
- D. Locate valves within reachable distance from equipment being served for easy access and operation. Do not locate valves with stems below horizontal.
- E. Check piping for interference with other trades; avoid placing water pipes over electrical equipment.
- F. Where rough-ins are required for equipment furnished by others, verify exact rough-in dimensions with Owner or equipment supplier before roughing-in.
- G. Install automatic temperature control valves, separable wells, humidifiers, pressure taps, and other items as called for and furnished by the temperature controls section.
- H. All fiberglass piping located outside shall be coated to protect piping from UV damage. Product shall be approved by piping manufacturer for specific application.
- I. Install expansion tank as indicated on the drawings and in accordance with manufacturer's instruction. Vent and purge air from hydronic system, charge tank with proper air charge as recommended by manufacturer. Route drain to floor drain. Set floor mounted tanks on concrete housekeeping pads.
- J. Install air separators in pump suction lines. Connect inlet and outlet piping. Run piping to compression tank with 1/4" per foot (2%) upward slope toward tank. Install drain valve. Separator shall not be supported by piping; install pipe hanger at inlet and outlet.
- K. Install manual air vents for each element of radiation coils at all high points in mains, branches, run outs and at other points likely to entrap air.
- L. Install automatic air vents in boiler and equipment rooms, at points where supply and return lines rise or drop. Extend 1/4" copper overflow line to floor drain and elbow into drain.
- M. Install calibrated balance valves with flow meter fittings at each terminal unit and elsewhere as indicated.
- N. Install Y-type strainers full size of pipeline, in accordance with manufacturer's installation instructions. Install pipe nipple and shutoff valve in strainer blow-down connection. Where indicated, provide drain line from shutoff valve to plumbing drain, full size of blow-down connection.
- O. Locate Y-type strainers in supply line ahead of the following equipment, and elsewhere as indicated, if integral strainer is not included in equipment:
 - 1. Temperature control valves.
 - 2. Pressure reducing valves.

3. Temperature or pressure regulating valves.
4. Pumps.
- P. Install control valves, flow switches, temperature sensor walls, gauge taps, flow meters, etc., provided by Temperature Controls Installer.
- Q. Coordinate installation height of basket strainer with pump suction. Adjust pump base height up if required.
- R. Install pump suction diffusers in accordance with manufacturer's recommendation.

3.2 PIPING TESTS ALL HEATING, AND COOLING SYSTEMS PIPING

- A. Test pressure piping in accordance with ANSI B31.
- B. General: Provide temporary equipment for testing, including pump and gauges. Test piping system before insulation is installed whenever feasible and remove control devices before testing. Test each natural section of each piping system independently, but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water or air and pressurize for the indicated pressure and time.
 1. Required test period is 2 hours.
 2. Test each piping system at 150% of operating pressure indicated, but not less than 25-psi test pressure.
 3. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure.
- C. Repair piping systems sections that fail the required piping test, by disassembly and reinstallation, using new materials to the extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.
- D. Drain test water from piping systems after testing and repair work has been completed.
- E. Pipes are to be thoroughly flushed and cleaned prior to being put into service. The flushing water must not go through any air handler, chiller, boiler, cooling or heating coils, terminal heating coils, or unit heaters. Strainer screens are to be removed prior to the flushing operation and are to be replaced when the flushing operation has been completed.
 1. As soon as possible after the flushing has been completed, the lines are to be filled with treated water to avoid the creation of a corrosive environment inside the pipes.
 2. Flushing operations are to be reviewed with and approved by the Owner's representative prior to any flushing operation. Pipe scale, welding slag, and any other debris shall be removed from pipes. The Owner's representative shall determine when the flushing operation is complete.

3.3 SLEEVES

- A. Install sleeves for piping passing through floors, roof, walls, concrete beams, and foundations.

3.4 ESCUTCHEONS

- A. Install escutcheons for pipes entering finished spaces.

3.5 MECHANICAL SLEEVE SEAL INSTALLATION

- A. Install mechanical sleeve seals at all pipe penetrations through foundations below grade.

- B. Loosely assemble rubber links around pipe and bolts and pressure plates located under each bolt head and nut. Push into sleeve and center. Tighten bolts until links have expanded to form watertight seal.

3.6 PIPE PENETRATIONS

- A. Penetrations shall be free of debris and dirt. Dam the penetration (when required) with an acceptable material. Apply firestop material to the penetration per manufacturer's installation instructions. Use a caulking gun, putty knife or other normal trade tools. Remove damming materials where necessary after cure. Clean up with Xylene.

END OF SECTION

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SECTION 23 2114 HYDRONIC SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Expansion tanks.
- B. Air vents.
- C. Air separators.
- D. Strainers.
- E. Pressure-temperature test plugs.
- F. Balancing valves.

1.2 RELATED REQUIREMENTS

- A. Section 23 2500 - HVAC Water Treatment: Pipe Cleaning.

1.3 REFERENCE STANDARDS

- A. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; 2015.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.

PART 2 PRODUCTS

2.1 EXPANSION TANKS

- A. Manufacturers:
 - 1. Amtrol Inc: www.amtrol.com.
 - 2. ITT Bell & Gossett: www.bellgossett.com.
 - 3. Taco, Inc: www.taco-hvac.com.
- B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psi (860 kPa), with flexible EPDM diaphragm or bladder sealed into tank, and steel support stand.
- C. Accessories: Pressure gage and air-charging fitting, tank drain; precharge to 12 psi (80 kPa).
- D. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check back flow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.

2.2 AIR VENTS

A. Manufacturers:

1. Armstrong International, Inc: www.armstronginternational.com.
2. ITT Bell & Gossett: www.bellgossett.com.
3. Taco, Inc: www.taco-hvac.com.

B. Float Type:

1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

2.3 AIR SEPARATORS

A. In-line Air Separators:

1. Manufacturers:

- a. Armstrong International, Inc: www.armstronginternational.com.
- b. ITT Bell & Gossett: www.bellgossett.com.
- c. Taco, Inc: www.taco-hvac.com.
- d. Spirotherm
- e. Substitutions: See Section 01 6000 - Product Requirements.

2. Cast iron for sizes 1-1/2 inch (40 mm) and smaller, or steel for sizes 2 inch (50 mm) and larger; tested and stamped in accordance with ASME BPVC-VIII-1; for 125 psi (860 kPa) operating pressure.

2.4 STRAINERS

A. Manufacturers:

1. Armstrong International, Inc: www.armstronginternational.com.
2. Flexicraft Industries: www.flexicraft.com.
3. Grinnell Products, a Tyco Business: www.grinnell.com.
4. Shurjoint Piping Products, Inc., a Tyco Business: www.shurjoint.com.
5. The Metraflex Company: www.metraflex.com.
6. Substitutions: See Section 01 6000 - Product Requirements.

B. Size 2 inch (50 mm) and Under:

1. Screwed brass or iron body for 175 psi (1200 kPa) working pressure, Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.

2.5 PRESSURE-TEMPERATURE TEST PLUGS

A. Manufacturers:

1. Peterson Equipment Company Inc: www.petesplug.com.
2. Sisco Manufacturing Company Inc: www.siscomfg.com.
3. Ferguson Enterprises Inc: www.fnw.com.

- 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Construction: Brass body designed to receive temperature or pressure probe with removable protective cap, and Neoprene rated for minimum 200 degrees F (93 degrees C).
- C. Application: Use extended length plugs to clear insulated piping.

2.6 BALANCING VALVES

- A. Size 2 inch (50 mm) and Smaller:
 - 1. Provide ball or globe style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and NPT threaded or soldered connections.
 - 2. Metal construction materials consist of bronze or brass.
 - 3. Non-metal construction materials consist of Teflon, EPDM, or engineered resin.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions.
- B. Provide manual air vents at system high points and as indicated.
- C. Provide air separator on suction side of system circulation pump and connect to expansion tank.
- D. Provide valved drain and hose connection on strainer blow down connection.
- E. Support pump fittings with floor mounted pipe and flange supports.
- F. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.
- G. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
- H. Pipe relief valve outlet to nearest floor drain.
- I. Clean and flush glycol system before adding glycol solution. Refer to Section 23 2500.
- J. Feed glycol solution to system through make-up line with pressure regulator, venting system high points.

3.2 MAINTENANCE

- A. See Section 01 7000 - Execution Requirements, for additional requirements relating to maintenance service.
- B. Provide service and maintenance of glycol system for one year from date of Substantial Completion at no extra charge to Owner.
- C. Perform monthly visit to make glycol fluid concentration analysis on site with refractive index measurement instrument. Report findings in detail in writing, including analysis and amounts of glycol or water added.
- D. Explain corrective actions to Owner's maintenance personnel in person.

END OF SECTION

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SECTION 23 2123 HYDRONIC PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. In-line circulators.

1.2 REFERENCE STANDARDS

- A. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.
- D. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Bell & Gossett
- B. Armstrong Pumps Inc
- C. SIHI Group
- D. Taco.

2.2 HVAC PUMPS - GENERAL

- A. Provide pumps that operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- B. Products Requiring Electrical Connection: Listed and classified by UL or testing agency acceptable to authority having jurisdiction as suitable for the purpose specified and indicated.

2.3 IN-LINE CIRCULATORS

- A. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 125 psi (860 kPa) maximum working pressure.
- B. Casing: Cast iron, with flanged pump connections.
- C. Impeller: Cast bronze keyed to shaft.
- D. Bearings: Oil-lubricated bronze sleeve.

- E. Shaft: Alloy steel with bronze sleeve, integral thrust collar.
- F. Seal: Mechanical seal, 225 degrees F (107 degrees C) maximum continuous operating temperature.
- G. Drive: Flexible coupling.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.
- C. Provide line sized shut-off valve and strainer on pump suction, and line sized soft seat check valve and balancing valve on pump discharge.
- D. Check, align, and certify alignment of base mounted pumps prior to start-up.
- E. Lubricate pumps before start-up.

END OF SECTION

**SECTION 23 2500.33
GEOTHERMAL HEAT TRANSFER FLUIDS**

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Glycol solutions.
 - 2. Precleaner for glycol-related piping system.
 - 3. Automatic glycol feed systems.
- B. Provide individual bulk fill connections utilizing 2" fill ports, with full port ball valves, threaded & capped.

1.2 SUBMITTALS

- A. Product Data for the following:
 - 1. Each glycol solution ratio.
 - 2. Glycol manufacturer's written documentation identifying bi-annual testing procedure.
 - 3. Glycol manufacturer's recommended piping-system cleaning process, including ratio of recommended precleaners.
 - 4. Automatic glycol feed system
- B. Glycol manufacturer's shipping manifest, identifying each product, respective volume and on-site delivery date.
- C. Glycol fill reports

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Glycol: Subject to compliance with requirements, provide products by one of the following:
 - 1. Dow Chemical Company
 - 2. Interstate Chemical Company
- B. Cleaning solutions: subject to compliance with requirements, provide products by one of the following:
 - 1. Dow Chemical Company
 - 2. Interstate Chemical Company
- C. Auto glycol feed: Subject to compliance with requirements, provide products by one of the following:
 - 1. J.L Wingert Co.
 - 2. Neptune Chemical Pump Co.
 - 3. Bell & Gossett

2.2 GLYCOL SOLUTIONS

- A. Freeze protection for specific systems shall be accomplished using the following glycol-based heat transfer fluids as indicated on plans.
 - 1. Fluids for propylene glycol (PG) systems requiring USP food-grade PG shall be either Dow's DOWFROST or Interstate's Intercool P-323.
- B. All glycol solutions shall be provided by a single manufacturer.
- C. Glycol solutions shall be ratio by volume and shall be premixed and prediluted by glycol manufacturer prior to manufacturer's shipment to site. Glycol concentrate shall not be mixed or diluted on-site in lieu of requirements identified herein.
- D. The water-to-air heat pump system shall have a 25% USP food-grade propylene glycol solution by volume, with freeze protection to 9°F and burst protection to -12°F.
- E. The glycol manufacturer shall analyze the fluid bi-annually to ensure the glycol solution continues to provide corrosion protection within industry standard; required testing shall be conducted at no additional cost to the owner.

2.3 AUTOMATIC GLYCOL FEED SYSTEMS

- A. Provide automatic glycol feed system(s) as indicated on plans, to include the following:
 - 1. Minimum fifty (50) gallon capacity polyethylene tank with hinged cover. Tank shall be translucent and manufactured to include a graduated-volume scale; scale shall be raised and painted a contrasting color.
 - 2. Four leg, painted carbon steel stand bolted to concrete equipment pad.
 - 3. NEMA 4X control panel, 115V, 8'-0" power cord, HOA selector for pump motor, 2-position main power switch.
 - 4. Bronze rotary gear pump capable of pumping required glycol solution ratios at 3.0 gpm at 100 psi.
 - 5. Accessories shall include: piping as required to complete installation, check valve, pressure gauge, adjustable pressure switch, strainer, isolation ball valves, relief valve with return line to tank, pump isolation and float switch for low-level pump shutoff.
 - 6. Provide pressure sensor for each closed system and subsystem (a single unit could provide makeup for more than one piping system), to alert the building management system upon activation of any automatic feed system or subsystem.

PART 3 EXECUTION

3.1 SYSTEM FILL AND SOLUTION ADJUSTMENTS

- A. Auto feed systems are intended for incidental system makeup only, and as such, shall not be used for system fill of any kind or adjustment of glycol ratio. Individual bulk fill connections shall be provided and shall be accomplished utilizing 2" fill ports, threaded & capped.

3.2 INITIAL FILL-FLUSHING

- A. The mechanical contractor shall meter the initial water fill for flushing of each system, for the purpose of hydrostatic pressure testing and/or system flushing; record the measured volume of the initial fill. The discharge resulting from draining the initial system fill shall also be metered and recorded, to provide a precise measure of system net volume, which yields the amount of water trapped in the system. This process will provide the basis for any required recommended adjustments by the glycol manufacturers to the premixed, prediluted glycol solution(s) prior to shipment and/or delivery (adjustment of the premixed glycol solution may be necessary to ensure the final solution strength is in compliance with the specifications).
- B. The initial dosage of protective chemical treatment shall be furnished by the water treatment company and added to system by the mechanical contractor.
- C. The mechanical contractor shall meter and record the volume of initial fill with potable water, intended to flush each system and conduct pressure test. The discharge resulting from draining the initial system fill shall also be metered and recorded, to provide a precise measure of system net volume, which also yields the amount of water trapped in the system; trapped water shall be drained by valves located and installed per Section 23 0523. This process will provide the basis for any required adjustments as recommended by the glycol manufacturer to the premixed, prediluted glycol solution(s) prior to shipment and/or delivery (adjustment of the premixed glycol solution may be necessary to ensure the final solution strength is in compliance with the specifications).
- D. Submit documentation identifying system(s) volume as measured and recorded from water meter by identifying initial fill, metered discharge and resulting trapped water.
- E. All costs shall be the responsibility of the mechanical contractor.

3.3 SYSTEM CLEANING-CHEMICAL

- A. Once the initial flush is complete and system drained, refill the system with clean water and provide the volume percentage of pre-cleaner for the removal of scale, oils and other extraneous materials as recommended by the glycol manufacturer
- B. Drain the system after the required circulation period as quickly as possible to prevent settling of foulants. Run circulating pumps and flush with clean potable water until the discharge water is clear. Monitor the system's pH for indication of adequate piping system's cleanliness.
- C. The glycol manufacturer's representative shall sample and have analyzed the discharge of the final clear-water rinse to ensure minimum piping system cleanliness is met per glycol manufacturer's standards. This step is critical and shall be satisfactorily completed prior to the introduction of glycol: only upon the glycol manufacturer's confirmation of system cleanliness, will the owner consent to final fill with glycol. Consequently, additional flushing/sampling/analysis sequences may be required to ensure the glycol manufacturer's required minimum cleanliness threshold is achieved.
- D. Once cleanliness is achieved, maintain and hold the entire system full of potable water until twelve hours prior to glycol delivery. During this holding period, remove, clean, and replace all strainers.
- E. Expended pre-cleaner solution shall be disposed of in compliance with local, state and federal requirements.

3.4 GLYCOL SOLUTION-FINAL FILL

- A. The contractor shall notify the owner's representative 72 hours in advance of the system's glycol fill, to allow the owner to observe the delivery and documentation of final fill volume. The contractor shall provide the owner a copy of the glycol manufacturer's shipping manifest on the day of delivery, to allow the owner's observation of initial and final metered readings, as indicated by the contractors meter identified above.
- B. The entire piping system, interior and exterior, shall be completely voided of clean water remaining after satisfactorily completed system cleaning to eliminate the possibility of any contamination. Once glycol is installed, if typical testing identifies any contaminants (total dissolved solids, bacteria, etc.) exceed maximum thresholds as determined by the glycol manufacturers recommendations, the contractor shall evacuate the entire system and refill with fresh, uncontaminated glycol.
- C. Install systems as indicated in the Specifications and as recommended by the manufacturer.
- D. Clearly label the direction of flow and the closed/open position of the isolation valves.
- E. Provide training to the owner's representative for testing and adding inhibitor to the closed loop systems.
- F. Should the glycol-volume ratio of the initial fill not meet the minimum glycol ratio requirements, additional concentrate (100% glycol by volume) shall be introduced to the system(s) until the minimum ratio(s) is attained. Any glycol solution removed from the system to create adequate volume for the introduction of concentrate, shall be disposed of in compliance with local, state and federal requirements.
- G. Upon completion of glycol fill and necessary adjustments, the glycol manufacturer's confirmation of satisfactory ratios as installed, submit a completed "Glycol Fill Report" using formatted document at the end of this Section. The owner's representative and the contractor shall sign a statement that the concentration test was witnessed and that the antifreeze level of the system is at the specified freeze temperatures.
- H. Provide MSDS sheets at each glycol auto feed unit for respective fluids. MSDS sheets shall be laminated and secured to adjacent wall in a permanent plexiglass frame.
- I. Provide a new, clean, polyethylene barrel (size at owner's discretion but maximum fifty five gallon) at each system's pressure relief valve related to each auto feed unit.
 - 1. Provide relief piping from relief valve to indirect discharge into barrel. Barrels shall be consistent, and either provided by the glycol manufacturer or as appropriate for glycol usage. Include all caps to allow water-tight seal.
 - 2. Provide relief piping from automatic air vent on each respective systems' air separator, to indirect discharge into barrel.

3.5 FIELD QUALITY CONTROL

- A. After each closed loop system has circulated glycol solution for a period of 30 days, submit to the glycol manufacturer a glycol sample from each system, in labeled containers provided by the manufacturer. Both the contractor and the owner shall be named on each sample, to ensure both receive a copy of the analytical results directly from the manufacturer.
- B. If the glycol manufacturer's review of the sample analysis indicates inhibitor (or other) adjustment is necessary, glycol and inhibitor concentrations shall be completed per manufacturers recommendations. Repeat sample at one month intervals until analysis returned requires no further action taken.

END OF SECTION

**SECTION 23 3113
METAL DUCTS**

PART 1 GENERAL

1.1 SUMMARY

- A. Provide material, devices, labor, and supervision necessary to fabricate and erect ductwork as required by the Drawings and this Section.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for metal ductwork materials and products.
- B. Shop Drawings: Submit ductwork shop drawings for entire facility, to scale, double line, indicating duct sizes, locations, fittings, equipment, accessories, structural clearances, etc. Do not install ductwork prior to approval of shop drawings by Engineer.

1.3 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. Ducts, plenums, apparatus casings, metal gauges, reinforcing, methods of supporting and hanging, and other sheet metal work as called for shall meet all functional criteria defined in Section VII, of the SMACNA "HVAC Duct Construction Standards Metal and Flexible" 1985 Edition. This shall be subsequently referred to as the SMACNA Manual. All ductwork must comply with all local, state and federal code requirements.
 - 2. Comply with applicable requirements of NFPA 91.

1.4 DESCRIPTION

- A. Air ducts shall be constructed as follows:
 - 1. Supply and return duct +4" w-g.
 - 2. Miscellaneous duct (exhaust, transfer grille, etc.) ±2" w-g.
 - 3. OA ducts and plenums ±3" w-g.

PART 2 PRODUCTS

2.1 GENERAL

- A. Shop fabricated sheet metal work shall be constructed of prime quality resquared tight coat galvanized steel, except where other type material is specified. Manufacturer's name and U.S. gauge number shall appear on each sheet.
- B. Duct sealant shall be installed per SMACNA Class A-all transverse joints, longitudinal seams and duct wall penetrations.
- C. Duct Sealant for Low Pressure Duct: UL labeled non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork. Sealant to be Mastic No. IG601 as manufactured by Hardcast or Engineer approved equivalent product manufactured by Ductmate or United McGill.

- D. Duct sealing tape and adhesive for high-pressure duct system by Hardcast Inc. or Engineer approved equivalent.
 - 1. Use Hardcast DT or JT pressureless tape in conjunction with Hardcast adhesive FTA20 on all fittings and joint connections.
 - 2. Use FTA20 full strength. Dip Hardcast tape in solution until saturated.
 - 3. Apply two wraps of wet tape on duct joint sections and fittings. Stretch tight to assure positive adhesion contact with the duct and to smooth out wrinkles.
 - 4. Follow manufacturer's written instructions.
- E. Round and/or oval ducts and fittings shall be as manufactured by Semco or United McGill.

2.2 DUCT

- A. Rectangular Duct:
 - 1. Sheet Metal: Except as otherwise indicated, fabricate ductwork from minimum 24 gage galvanized sheet steel complying with ASTM A527, lockforming quality; with G90 zinc coating in accordance with ASTM A525; and mill phosphatized for exposed locations.
 - 2. Aluminum for Ducts: ASTM B209 (ASTM B209M); aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength.
 - 3. Rectangular duct shall be fabricated to the SMACNA functional criteria for the pressure class indicated on the Drawings.
 - 4. Pittsburgh lock shall be used on all longitudinal seams. All longitudinal seams will be sealed with mastic sealant. Snaplock is not acceptable.
 - 5. Exhaust Duct shall be 18 gauge aluminum.
- B. Rectangular Duct Fittings:
 - 1. Elbows shall be constructed with centerline radius of not less than 1.5 times duct width; where space conditions will not permit this radius or where indicated on the Drawings, square elbows with single thickness streamline turning vanes shall be used. Provide trailing edge extension for elbows in series.
 - 2. Slopes for transitions or other changes in dimension shall be minimum 1 to 3.
 - 3. All duct seams and joints shall be sealed to SMACNA Class A requirements.
 - 4. Rectangular branch taps from mains shall be 45° entry fittings.

2.3 PLENUMS AND APPARATUS CASINGS

- A. Plenums shall be fabricated of same material as duct connecting to plenum and shall be two metal gauges heavier than gauge of largest duct connecting to plenum. Plenums used for connecting to exterior louvers shall have all seams welded watertight at the floor and 6 inches up the wall. In addition, plenums used for connection to exterior intake louvers shall have the floors sloped to a drain pipe connection and the drain piped to the nearest floor drain.
- B. Apparatus Casings shall be fabricated of not less than 18 gauge galvanized steel and shall be braced for rigidity. Bracing shall consist of not less than 2" x 2" x ¼ galvanized structural steel angles, spaced not more than 3'-0" on center. Main entry doors shall be provided for access to all apparatus and shall be fabricated of two thicknesses of not less than 22 gauge galvanized steel with 1" thick rigid glass filler. Provide 2" x 2" x ¼" galvanized welded, angle frames, hinges, airtight gaskets and two Young Regulator Co., No. 1335 or 1340 latches.

2.4 DUCTWORK SUPPORT MATERIALS

- A. Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

2.5 DUCT ACCESSORIES

- A. Transverse Duct Joints: May be made with the Ductmate Systems or an Engineer approved equivalent. The Ductmate Systems are to be used in accordance with the Ductmate factory installation and assembly instructions, (1-800-245-3188).
 - 1. Ductmate 440 or a Butyl Rubber Gasket which meets Mil-C 18969B, Type II Class B, T-C-1796 A, Type II Class B, and TTS-S-001657 must also pass UL-723. This material, in addition to the above, shall not contain vegetable oils, fish oils, or any other type vehicle that will support fungal and/or bacterial growth associated with dark, damp areas of ductwork. The recommended test procedure for bacterial and fungal growth is found in 21CFR 177, 1210 closures with sealing gaskets for food containers.
 - 2. Ductmate or W.D.C.I. proprietary duct connection systems are acceptable. Duct constructed using these systems shall refer to the manufacturer's guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcements.
 - 3. Formed on flanges (T.D.C./T.D.F./T-25A/T-25B) are acceptable. Formed on flanges shall be constructed as SMACNA T-25 flanges, whose limits are defined on Page 1.36 1985 SMACNA Manual, First Edition. No other construction pertaining to formed on flanges will be accepted. Formed on flanges shall be accepted for use on ductwork 42" wide or less, 2" static positive pressure or less, and shall include the use of corners, bolts and cleat. (Over 42", the reinforcement/joint deflection criteria no longer conform to the UMC).

PART 3 EXECUTION

3.1 INSTALLATION

- A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve airtight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.
- B. Inserts: Install concrete inserts for support of ductwork in coordination with form work, as required to avoid delays in work.
- C. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.
- D. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Install offsets, angles, and transitions as may be required to avoid interferences with other work, install streamlined easements around obstructions where necessary to pass obstructions through ducts. Maintain full capacity of ducts at offsets, angles, transitions and easements, except where Drawings indicated use of reducing or increasing transitions. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

- E. Limit clearance to ½" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.
- F. Where ducts pass through interior partitions and exterior walls, conceal the space between the construction opening and the duct or duct-plus-insulation with sheet metal flanges of the same gauge as the duct. Overlap the opening on all sides by at least 1½".
- G. Coordinate duct installations with installation of accessories, equipment, controls and other associated work of the ductwork system.
- H. Each duct section shall be rigidly supported from structure. Attach hangers to structure with expansion plugs, concrete inserts, beam clamps or other approved means. Rubber-in-shear isolators shall be installed in hangers for ducts in equipment rooms, to prevent vibration transmission to the structure.
- I. Install as indicated on the Drawings duct mounted equipment as specified in other Sections.
- J. Duct sizes shown on Drawings are net inside dimensions. Increase duct sizes as required to allow for installation of duct liner, where specified.
- K. Application of Duct Sealant: All ducts to be properly sealed. Specified duct sealant to be pumped or painted into all joints and seams on all ductwork systems. Sealant shall be allowed to set 48 hours before any air pressure is applied to system.
- L. Electrical Equipment Spaces: Do not route ductwork through electrical equipment spaces and enclosures. Do not run ductwork above electrical panels.

3.2 EQUIPMENT CONNECTIONS

- A. General: Connect metal ductwork to equipment as indicated; provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery.

3.3 ADJUSTING AND CLEANING

- A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.
- B. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.
- C. Balancing: Refer to Section P2 23 0593, "Testing, Adjusting and Balancing for HVAC" for air distribution balancing of metal ductwork; not work of this section. Seal any leaks in ductwork that become apparent during the balancing process.

3.4 DUCTWORK LEAKAGE CRITERIA

- A. All transverse joints and longitudinal seams shall conform to SMACNA's sealing requirements as defined on page 1-6 of the 1985 SMACNA Manual, First Edition. Duct sealing shall be per paragraph 2.1B.

B. Variable Air Volume Systems/Return Ductwork

1. Ductwork shall be leak tested according to SMACNA HVAC Air Duct Leakage Test Manual.
2. Ducts having a pressure class of +/-3" wc, or higher shall have representative sections tested. A minimum of 25% of the total installed duct area for the designated pressure class shall be tested. This is not necessarily 25% of each floor. Include ducts in shafts in the representative sample.
3. The maximum permissible duct leakage class of the tested duct shall be as follows:
 - a. 3" pressure class – rectangular: leakage class 8
 - b. 3" pressure class – round: leakage class 4
 - c. 4" and 6" pressure class – rectangular: leakage class 4
 - d. 4" and 6" pressure class – round: leakage class 2
4. Negative pressure systems may be tested with positive pressure tests.
5. Submit report to Engineer at the end of the project in O&M Manuals. Highlight duct sections that were tested.

3.5 DUCTWORK LEAKAGE TESTING

- A. Installed ductwork shall be tested prior to installation of access doors, take-offs, etc.
- B. All leak testing shall be witnessed by the engineer or representative of the engineer. The contractor shall give the engineer 72 hours notice prior to testing. Any testing not witnessed by the engineer or his/her representative shall be considered invalid and will be redone.
- C. The testing shall be performed as follows:
 1. Perform testing in accordance with HVAC Air Duct Leakage Test Manual.
 2. Use a certified orifice tube for measuring the leakage.
 3. Define section of system to be tested and blank off.
 4. Determine the percentage of the system being tested.
 5. Using that percentage, determine the allowable leakage (cfm) for that section being tested.
 6. Pressurize to operating pressure and repair any significant or audible leaks.
 7. Repressurize and measure leakage.
 8. Repeat steps 6 and 7 until the leakage measured is less than the allowable defined in Step 5.
- D. Major supply, return and exhaust duct runs or ducts running through chases shall be pressure tested before branch ducts are added or chases are closed. It is recommended that the first 100'-300' of ductwork installed be tested to insure the quality of the workmanship at an early stage.

END OF SECTION

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**SECTION 23 3300
AIR DUCT ACCESSORIES**

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Volume dampers.
2. Motorized control dampers.
3. Turning vanes.
4. Duct-mounting access doors.

1.2 SUBMITTALS

A. Product Data: For the following:

1. Volume dampers.
2. Motorized control dampers.
3. Turning vanes.
4. Duct-mounting access doors.

B. Shop Drawings:

1. Product Data: Submit manufacturer's technical product data and installation instructions for metal ductwork materials and products.

1.3 QUALITY ASSURANCE

A. Codes and Standards

1. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
2. Fire, Smoke, and Combination Dampers:
 - a. Constructed and tested in accordance with UL Safety Standard 555 and 555S, for 1 1/2 hour fire protection rating, with 165oF fusible link, and shall bear UL label.
3. Ducts, plenums, apparatus casings, metal gauges, reinforcing, methods of supporting and hanging, and other sheet metal work as called for shall meet all functional criteria defined in the SMACNA "HVAC Duct Construction Standards Metal and Flexible" 2005, 3rd Edition. This shall be subsequently referred to as the SMACNA Manual. All ductwork must comply with all local, state and federal code requirements.
4. Comply with applicable requirements of NFPA 91.

PART 2 PRODUCTS

2.1 MOTORIZED DAMPERS

- A. Furnish and install a low leakage thermally insulated blade damper with galvanized steel interlocking blades. Frame shall be 16 gage. Blades shall be 16 gage with a minimum insulating value of R-3.3.
 - 1. Manufacturers
 - a. Tamco 9000 series
 - b. Anemostat
 - c. Enertech
 - d. Ruskin
 - e. Engineer approved equivalent.

2.2 VOLUME DAMPERS

- A. Manual Volume Dampers: Fabricated of same material as ducts, two metal gauges heavier than duct and hemmed 1" all around, mounted on 3/8" square rod with saw slot position indicated. Pivot bearings, elocking position regulator, Young Regulator Co., Series 443.
 - 1. Where positioning regulator is not accessible, provide coupling and extension rod with regulator for ceiling wall or floor installation, as required. Young Series 301 and 315 for ceiling, Series 270-302 for walls.

2.3 TURNING VANES

- A. Manufacturers:
 - 1. Aero Dyne; Ductmate; Anemostat; Barber Coleman; Duro Dyne; or Hart & Cooley.
- B. Provide single thickness streamline type, except provide turning vanes with trailing edge at elbows which change dimensions or at consecutive elbows.
- C. Provide manufactured turning vanes and vane runners, fabricated from the same material as the duct, and constructed in accordance with SMACNA "HVAC Duct Construction Standards". Tab spacing shall be SMACNA standard. Rail systems with non-standard tab spacings shall not be accepted. All tabs shall be used, do not skip tabs. Mounting rails shall have friction insert tabs which align the vanes automatically. Vanes shall be subjected to tensile loading and be capable of supporting 250 lbs. when fastened per the manufacturer's instructions.

2.4 DUCT-MOUNTING ACCESS DOORS

- A. General:
 - 1. Shall be of same material as ducts in which they are installed, fabricated of two thicknesses of not less than 22 gauge, with 1" thick rigid glass fiber filler. Provide sheet metal frame, airtight gasket and two cam latches. Access doors and panels shall be 2 inches smaller than duct width and square for ducts 18" wide and larger, maximum size shall be 24" x 24" unless noted otherwise. For ducts less than 18" wide, access doors and panels shall be 2" smaller than duct width and 18" long. Pre-manufactured doors shall be hinged and shall be of adequate size to allow easy access to hardware which needs to be maintained.

2.5 QUADRANT LOCKS

- A. Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12".
- B. Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

PART 2 EXECUTION

3.1 APPLICATION AND INSTALLATION

- A. Install manual volume dampers in all supply, return and exhaust duct systems as required for controlling air volumes to trunk ducts, branch ducts, outlets and inlets. Contractor shall install a complete system of dampers as required for balancing air systems.
- B. Coordinate duct installations with installation of accessories, equipment, controls and other associated work of the ductwork system.
- C. Install access panels for inspection and servicing of duct mounted equipment; reheat coils, sound attenuators, and smoke and fire dampers.
- D. Install turning vanes in all square or rectangular 90° elbows in supply, return, and exhaust air systems.

END OF SECTION

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**SECTION 23 3700
AIR OUTLETS AND INLETS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Registers/grilles.

1.2 RELATED REQUIREMENTS

- A. Section 09 9000 - Painting and Coating: Painting of ducts visible behind outlets and inlets.

1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. American Louver Company: www.americanlouver.com.
- B. Carnes Company HVAC: www.carnes.com.
- C. Hart & Cooley, Inc: www.hartandcooley.com.
- D. Krueger: www.krueger-hvac.com.
- E. Price Industries; www.price-hvac.com.
- F. Titus: www.titus-hvac.com.
- G. Anemostat
- H. Tuttle & Bailey
- I. Substitutions: See Section 01 6000 - Product Requirements.

2.2 WALL SUPPLY REGISTERS/GRILLES

- A. Type: Streamlined and individually adjustable blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing with spring or other device to set blades, vertical face, double deflection.
- B. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting and gasket.
- C. Fabrication: Steel with 20 gage, 0.0359 inch (0.91 mm) minimum frames and 22 gage, 0.0299 inch (0.76 mm) minimum blades, steel and aluminum with 20 gage, 0.0359 inch (0.91 mm) minimum frame, or aluminum extrusions, with factory baked enamel finish.
- D. Color: As shown on the drawings.
- E. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.

2.3 WALL EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing, with spring or other device to set blades, vertical face.
- B. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting.
- C. Fabrication: Steel frames and blades, with factory baked enamel finish.
- D. Color: As shown on the drawings.
- E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- C. Paint ductwork visible behind air outlets and inlets matte black. Refer to Section 09 9000.

END OF SECTION

**SECTION 23 7500
OUTDOOR AIR DEHUMIDIFICATION HEAT PUMP**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The extent of outdoor air dehumidification heat pump unit work is shown on Drawings and in schedules, and by requirements of this Section, and is hereby defined to include, but not necessarily be limited to compressors, dehumidification cooling coil, hot gas reheat coil, water-cooled condensers, supply fan & motorized damper, exhaust fan & motorized damper, and electric coils with SCR control. The outdoor air heat pump system supplies conditioned ventilation air primarily for the classroom heat pumps as shown on the drawings.
- B. Actual/final dimensions of manufactured unit(s) in interior locations will be critical in successfully guiding and landing equipment in its final location, including achieving manufacturer's recommended access clearances which shall be adhered to.

1.2 CODES AND STANDARDS

- A. Installer: A firm with at least 5 years of successful installation experience on projects with dehumidification heat pumps.
- B. NFPA Compliance: Comply with applicable provisions of NFPA Stds. 70 and 90A, pertaining to construction and installation of dehumidification heat pump units.
- C. Flame-Smoke Ratings: Except as otherwise indicated, provide packaged rooftop air-conditioning unit thermal insulation with flame-spread rating of 25 or less, fuel-contributed of 50 or less, and smoke-developed rating of 50 or less.
- D. AMCA Standards: Comply with Air Movement and Control Association standards as applicable to testing and rating fans, sound rating for air moving devices, and testing louvers, dampers and shutters.
- E. ARI/AHRI Certification: Provide dehumidification heat pump units which comply with Air-Conditioning and Refrigeration Institute standards 210, 270 and 1060, and display ARI/AHRI's certification symbol.
- F. UL Listing or ETL Compliance: Provide dehumidification heat pump units which comply with applicable portions of UL 465, and with electrical components that bear UL labels.
- G. ANSI/ASHRAE Compliance: Comply with installation requirements of ANSI/ASHRAE 15, Safety Code for Mechanical Refrigeration.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver dehumidification heat pump unit with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective framing.
- B. Handle heat pump unit carefully to avoid damage to components, enclosures and finish. Do not install damaged components; replace and return damaged components to heat pump unit manufacturer.
- C. Store heat pump unit in clean dry place and protect from weather and construction traffic. Equipment arriving prior to setting in final location on site shall be stored consistent with Section 01 6000 - Product Requirements.

1.4 SUBMITTALS

- A. Shop Drawings: Shop drawings shall indicate assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.
- B. Product Data: Product data shall indicate performance data relative to the information scheduled on the drawings. In addition, provide dimensions, weights, capacities, ratings, fan performance, motor electrical characteristics, and gages and finishes of materials.
- C. Sound power level data, and test methods used to generate data.
- D. Provide fan curves with specified operating point clearly plotted.
- E. Submit sound power levels for both fan outlet and casing radiation at rated capacity.
- F. Submit product data of filter, including media, performance data, frames and assembly.
- G. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring clearly delineating factory installed versus field installed wiring.
- H. Submit manufacturer's installation instructions.
- I. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- J. Coordination Documentation: The heat pump vendor and controls vendor shall cross-review both submittals – Sections 23 7500 and 23 0900 DDC Controls - for consistency, and if any items are not consistent, shall resolve such discrepancies prior to submitting to the Contractor. Submit a written statement signifying all issues relating the integration of equipment of this Section and controls have been fully and completely coordinated to ensure full and complete operation per the contract documents. Submittal will be considered incomplete and subject to rejection without the written statement as specified.
- K. Warranties: Submit warranties as indicated in Part 3 of this Section.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate units for any purpose, temporary or permanent, prior to owner's occupation of the building at this project's Substantial Completion, as mutually determined by the architect and owner.
- B. Units shall not be operated to provide any function of HVAC during any phase of construction, either temporary or permanent, including building dehumidification, prior to this project reaching Substantial Completion. At their own discretion and cost, contractor(s) shall provide independent equipment to provide temporary HVAC, and/or dehumidification, related to construction as required to achieve their desired or project-required results.

PART 2 PRODUCTS

2.1 GENERAL

- A. Basis of design: Trane
- B. Request for consideration of equipment by other manufacturers will be accommodated through the substitution process.
 - 1. A request for consideration of other equipment as possible equivalent to the basis of design shall include a complete package of documentation fully identifying compliance with contract documents.

Outdoor Air Dehumidification

Heat Pump
23 7500 - 2

Issued for Bid
01-23-2026

2. Extent of documentation shall include but not limited to: performance data, fabrication data, dimensional and weight data, electrical data, full disclosure of factory mounted controls, parts lists, wiring diagrams clearly differentiating between factory and field wiring, etc. Also see requirements of this Section and of 01 3300 Submittal Procedures.
 3. The documentation package will be reviewed for compliance with the contract documents.
 4. Approval of equivalent equipment will only be acknowledged by addendum.
- C. Units shall be factory run tested to ensure all systems and components function satisfactorily for continuous operation, including all electrical circuits for continuity.
- D. Provide factory-assembled, self-contained, heat pump unit of types, sizes, ratings and capacities indicated; consisting of, but not necessarily limited to, casings/cabinets, fans, fan motors and drives, condensers, compressors, heating section, filter units, dampers, electrical safety controls, environmental system controls and accessories required for a complete and fully operational installation.

2.2 SOUND POWER LEVELS

- A. Sound power levels shall be provided for each octave band and shall not exceed data shown in attachment to this Section. Sound power data shall be within acceptable limits as identified in AMCA 311.

2.3 ENCLOSURE

- A. Base rail. Welded 14-gauge galvanized perimeter base rail. Exterior units shall be provided with a 12" high base rail; rails for interior units shall 4" or 6". Intermediate support rails shall be 24 gauge galvanized steel. The entire base rail assembly shall be painted with a phenolic coating. The base rail assembly system shall be factory engineered to withstand the weight and weight distribution of the entire unit.
- B. Unit shall be double wall 18-gauge galvanized outer panels and G90 24-gauge galvanized metal inner liners.
- C. Floor panels shall be 14 gauge hot rolled steel, continuously welded to adjacent panels and also the base frame steel tubing. This fully welded construction will create a watertight 'bathtub' for any liquids spilled or leaked inside the unit. Welded floor panels system also serves to provide floor rigidity and support for internal components.
- D. Insulation.
1. Units intended for exterior applications – i.e. roof mounted with service corridor: all walls, doors, roof and floor including those associated with the service vestibule shall be insulated with 2" closed cell spray foam R12.
 2. Inner walls (i.e. internal partitions in contact with moving air) shall be insulated with 2" R9, 2.5 lb./cu. ft. non-compressed mineral wool.
- E. Low leakage motorized dampers shall be included for outside air, exhaust air and return air, and as otherwise required for identified operation. Dampers shall comply with AMCA rating program for standard air leakage.
- F. All doors and panels shall be hinged – removable panels will not be accepted. Access doors and panels shall allow easy access to internal components within each section. Each door shall have a minimum of two cam latches. Weatherproof compression gaskets shall seal between the door and unit casing to produce an airtight seal.

- G. Side Service Access: Where exterior units are shown with service corridor's, the intent is to provide complete access for service and maintenance from one or both sides as shown. See mechanical drawings for clearances to access for maintenance.
- H. Grease fittings.
 - 1. Grease fittings shall be stainless steel.
 - 2. To access bearings which are hidden, inaccessible or in hazardous locations, provide remote lube fitting systems. When able to gather multiple remote fittings in one location, also provide remote junction block(s).
 - 3. All bends in feed line tubing shall be made with metallic fittings (90 degree elbows). Tubing shall be mechanically restrained (clamped).
 - 4. Each remote fitting shall be identified as to specific component served.
 - 5. Provide adhesive schematic clearly identifying location of all grease fittings. Locate schematic on outside of unit adjacent unit's nameplate.
- I. Each module shall be independently labeled – i.e. Supply Fan, Energy Recovery Wheel, Electrical, Controls, etc. Labels shall be adhesive and as otherwise defined in 23 0553 Identification for HVAC.

2.4 INTEGRATED WATER SOURCE HEAT PUMP

- A. The head pressure shall be controlled by the system's internal flooding valve.
- B. Provide manual air vent relief valves in all hydronic piping at the highest point in the internal piping.
- C. Head pressure control valves, actuator modulated, controlled by DDC via pressure control. Unit shall be suitable for geothermal applications. Unit shall have low leaving water temperature protection (freeze stat) safety switch. Internal water shutoff valves, actuator modulated, are controlled via internal controls.
- D. Integrated heat pump's hydronic piping connections shall be completed by contractor using heat pump hose kits. See 23 8146 for specification. Where internal space is limited to make connections, disassemble hose kit and install components individually.

2.5 COMPRESSORS

- A. VFD driven scroll: hermetic type, heavy-duty, multiple compressors where necessary to meet performance. A factory-mounted sensor deactivating one compressor when the load reaches the mid-range of the system's capacity shall stage the compressors.
- B. Equipped with high and low pressure safety switches with thermal overload.
- C. Installed with dedicated vibration isolation.
- D. Compressors shall be provided in pairs:
 - 1. Units with two compressors: each compressor shall be capable of lead/lag. Lead compressor shall be capable of capacity modulation from 10% to 100% of nominal capacity, without use of frequency inverter or hot gas bypass.
 - 2. Units with four or more compressors: each pair shall be capable of lead/lag; first compressor in each pair shall be capable of capacity modulation from 10% to 100%, with second compressor standard.

2.6 ELECTRICAL

- A. The electrical control panel shall be easily accessible on one side so that all service can be performed from the side of the unit. It shall be of adequate size so as to house all electrical controls and devices.
 - 1. The electrical controls shall include low voltage transformers to supply 24 VDC control power, clearly labeled high- and low-voltage terminal strips, high- and low-pressure control (with manual reset of the high-pressure cutout and automatic reset of low pressure cutout), and an anti-short cycling timer delay to protect against compressor cycling.
 - 2. Electrical control panels may ship loose on some units requiring field mounting and wiring terminations. Electrical contractor shall mount these remote panels, provide all conduit and wiring between panel and unit including control wiring. Manufacturer's representative shall verify all terminations before startup and electrical contractor shall modify as directed by the representative.
 - 3. Units shall be limited to the maximum (peak) electrical kW input identified in the contract documents.

2.7 CONTROLS

- A. The controls contractor shall provide controls for the unit. The unit shall come with a terminal strip for the connection point.

2.8 EXHAUST AIR BLOWER ASSEMBLY

- A. Acceptable fans for the exhaust air system are DWDI AF or fanwall array, depending on constraints of overall unit dimensions and performance.
- B. Fans shall be heavy duty industrial type. Performance rating based on AMCA 210 for performance and AMCA 300 for sounds. Fans shall be selected for stable operations at least 20% under the first critical speed of the fan.
- C. The blower housing shall be made of galvanized steel and mounted on permanently lubricated sealed ball bearings. Bearings shall be heavy duty type with a minimum L50 rating in excess of 200,000 hours at design operating speed. The blower assembly shall be forward curved, centrifugal; it shall be dynamically and statically balanced with a stainless steel fan shaft. The blower housing shall be vibration spring isolated.
- D. Blower Pulley Assembly: The driver pulley and the blower pulley shall be made of cast iron. The motor sheave shall be a variable pitch type to allow for field adjustment of CFM and external static pressure, and shall be dynamically and statically balanced with a stainless steel fan shaft. The drive overload service factor shall be a minimum of 1.2.
- E. Blower Motors:
 - 1. The motor shall be ECM, class B insulated, continuous-duty, 40C ambient, three-phase overloads. The motor shall be UL listed.
 - 2. Shall be NEMA Premium® efficiency.
 - 3. Shall be mounted on spring vibration isolators.

2.9 AIR FILTERS

- A. Unit shall ship with shipping filters and shall not operate in any manner with shipping filters in place. Permanent filters shall be 2" pleated, disposable, MERV 8.

2.10 EXTRA MATERIALS

- A. Filters: In addition to shipping filters installed in the unit at the factory, furnish (3) sets extra permanent filters matching products described above, packaged with protective covering for storage and identified with labels clearly describing contents.

PART 3 EXECUTION

3.1 INSPECTION

- A. Installer shall examine areas and conditions under which heat pump units are to be installed and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF PACKAGED HEAT PUMP UNITS

- A. Comply with paragraph 1.5 Environmental Requirements, above.
- B. Unit shall ship with temporary/shipping filters in place; ensure they remain in place during entire construction period. Replace temporary/shipping filters with 1st set of permanent filters at start-up, 2nd set Substantial Completion, and 3rd and final set at Final Completion.
- C. Install unit where shown in accordance with equipment manufacturer's written instructions, and recognized industry practices, to ensure that units comply with requirements and serve intended purposes.
- D. Coordinate with other work, including ductwork, structural, vibration isolation, piping and electrical work, as necessary to interface installation of heat pump unit with other work.
- E. Temporary Closure: Upon completion of installation, provide protective covering on heat pump unit ductwork connection openings to prevent entrance of dust and debris into equipment.
- F. Install vibration isolators to properly isolate the unit vibration from the structure.
- G. Contractor shall extend main cooling coil condensate drains through 4" deep (min.) traps, to floor drain or as shown on Drawings.
- H. Duct Connections: Provide ductwork, accessories, and flexible connections as specified within Division 23.

3.3 GROUNDING

- A. Provide positive equipment ground for ventilation heat pump unit components.

3.4 MANUFACTURER'S START-UP

- A. Manufacturer shall provide a factory authorized service representative for unit start up. Startup procedure and respective documentation shall be submitted as part of shop drawing review process. Completed start-up documentation shall be submitted to the owner.
- B. The owner/engineer shall confirm all systems completely installed prior to start-up being scheduled.
- C. Both the mechanical equipment factory start-up and temperature controls contractor start-up personnel shall be onsite together to assist each other as required for start-up.
- D. No portion of onsite test and balance shall proceed until satisfactory start-up of all equipment has been satisfactorily documented by the manufacturer and confirmed by the owner.

Outdoor Air Dehumidification

- E. See Sections 01 4000 Quality Requirements, 01 7500 Starting and Adjusting and 23 0500 Common Results for HVAC, for additional start-up information.
- F. Consistent with other Sections, manufacturer shall have permanent representation for startup and service within 50 miles and shall respond to service calls within 24 hours.

3.5 TRAINING

- A. The equipment manufacturer shall provide 12 hours of training at the facility, composed of (3) 4-hour sessions. The Owner shall schedule the sessions at their discretion, but in general shall be held upon completed start-up, during the full heating season and during the full cooling season; all sessions to be complete within one calendar year of startup. Sessions shall include but not limited to: review of O&M's, normal equipment operation, and without risk of damage to any equipment, simulate faults, failures/safety alarms and fully demonstrate trouble-shooting techniques.

3.6 WARRANTY

- A. Provide a full parts warranty for two years from manufacturer's start-up.
- B. Special parts warranty:
 - 1. Provide five-year parts warranty for compressors.
 - 2. Provide five-year limited parts warranty for heat exchanger.

END OF SECTION

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**SECTION 26 0500
COMMON WORK RESULTS FOR ELECTRICAL**

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Electrical equipment coordination and installation.
 - 2. Sleeves for raceways and cables.
 - 3. Sleeve seals.
 - 4. Grout.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

- C. Sleeves for Rectangular Openings: Galvanized sheet steel.

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Carbon Steel. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Comply with applicable provisions of Occupational Safety and Health Act (OSHA), NFPA Standards and Pamphlets, NEIS Standards, and common work place practice.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 01.

END OF SECTION

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**SECTION 26 0501
MINOR ELECTRICAL DEMOLITION**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical demolition.

1.2 RELATED REQUIREMENTS

- A. Section 01 7000 - Execution and Closeout Requirements: Additional requirements for alterations work.

1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Sustainable Design Documentation: Submit certification of removal and appropriate disposal of abandoned cables containing lead stabilizers.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as shown on Drawings. Confer with owner prior to demolition to understand wire color code method.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition drawings are based on casual field observation and existing record documents.
- D. Report discrepancies to Architect/Engineer before disturbing existing installation.
- E. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outage with owner. Owner owns and maintains medium voltage distribution system throughout site.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

- D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Obtain permission from Owner at least 24 hours before partially or completely disabling system.
 - 2. Make temporary connections to maintain service in areas adjacent to work area.
- E. Existing fiber optic System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Obtain permission from Owner at least 24 hours before partially or completely disabling system.
 - 2. Make temporary connections to maintain service in areas adjacent to work area.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:
 - 1. PCB-containing electrical equipment, including transformers, capacitors, and switches.
 - 2. PCB- and DEHP-containing lighting ballasts.
 - 3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned wiring to source of supply.
- D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors and patch surfaces.
- E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
- F. Disconnect and remove abandoned panelboards and distribution equipment.
- G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- I. Repair adjacent construction and finishes damaged during demolition and extension work.
- J. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.4 CLEANING AND REPAIR

- A. See Section 01 7419 - Construction Waste Management and Disposal for additional requirements.
- B. Clean and repair existing materials and equipment that remain or that are to be reused.
- C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

END OF SECTION

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**SECTION 26 0513
MEDIUM-VOLTAGE CABLES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Medium voltage cable.
- B. Cable accessories.

1.2 REFERENCE STANDARDS

- A. IEEE 48 - IEEE Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV; 2009.
- B. NEMA WC 74 - 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy; 2022.
- C. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide for cable, terminations, and accessories.
- C. Test Reports: Indicate results of cable test in tabular form and in plots of current versus voltage for incremental voltage steps, and current versus time at 30 second intervals at maximum voltage.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Project Record Documents: Record actual sizes and locations of cables.
- F. Maintenance Data: Include instructions for testing and cleaning cable and accessories.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles (160 km) of Project.
- C. Installer Qualifications: Authorized installer of specified manufacturer with service facilities within 100 miles (160 km) of Project.
- D. Products: Listed, classified, and labeled as suitable for the purpose intended.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 MEDIUM-VOLTAGE CABLE

- A. Medium Voltage Cable: NEMA WC 74 cross-linked polyethylene insulated cable.
 - 1. Voltage: 15 kV, grounded .
 - 2. Conductor: Aluminum, compact round, stranded, with foil conductor shield, Type MV105.
 - 3. Construction: Preferred: Three (allowed single) conductor with metal tape insulation shielding.
 - 4. Insulation thickness: 133%.
 - 5. Armor Material: Aluminum.
 - 6. Armor Design: Interlocked metal tape.
 - 7. Armor Jacket: PVC.

2.2 CABLE ACCESSORIES

- A. Manufacturers:
 - 1. 3M: www.3m.com/#sle.
 - 2. Prysmian Power Cables and Systems: www.us.prysmian.com
 - 3. TE Connectivity; Raychem Products: www.te.com.
- B. Modular Cable Terminations: IEEE 48, Class 1, molded-rubber cable termination in kit form with stress cone, ground clamp, non-tracking rubber skirts, load break connector, rubber cap, and aerial lug.
- C. Tape Terminations: IEEE 48; Class 1, tape termination kit with semi- conductive tape, stress control tape, splicing tape, vinyl plastic tape, stress cone, mechanical ground straps, and cable preparation kit.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that trench or manholes are ready to receive cable.
- B. Verify routing and termination locations of cable bank prior to rough-in.
- C. Cable routing is shown in approximate locations unless dimensioned. Route as required to complete wiring system.

3.2 INSTALLATION

- A. Avoid abrasion and other damage to cables during installation.
- B. Use suitable lubricants and pulling equipment.
- C. Sustain cable pulling tensions and bending radii below recommended limits.
- D. Ground cable shield at each termination and splice.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect exposed cable sections for physical damage.
- C. Inspect cable for proper connections as indicated.
- D. Inspect shield grounding, cable supports, and terminations for proper installation.
- E. Inspect and test in accordance with NETA ATS, except Section 4.
- F. Perform inspections and tests listed in NETA ATS, Section 7.3.3. The cable time domain reflectometer (TDR) measurements on each conductor listed as optional are not required.

3.4 PROTECTION

- A. Protect installed cables from entrance of moisture.

END OF SECTION

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SECTION 26 0519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Single conductor building wire.
- B. Underground feeder and branch-circuit cable.
- C. Service entrance cable.
- D. Manufactured wiring systems.
- E. Wiring connectors.

1.2 RELATED REQUIREMENTS

- A. Section 26 0501 - Minor Electrical Demolition: Disconnection, removal, and/or extension of existing electrical conductors and cables.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013.
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011.
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010 (Reapproved 2014).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2014).
- E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2010.
- F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2013.
- G. FS A-A-59544 - Cable and Wire, Electrical (Power, Fixed Installation); Federal Specification; Revision A, 2008.
- H. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- I. NECA 121 - Standard for Installing Nonmetallic-Sheathed Cable (Type NM-B) and Underground Feeder and Branch-Circuit Cable (Type UF); 2007.
- J. NEMA WC 70 - Nonshielded Power Cable 2000 V or Less for the Distribution of Electrical Energy; 2009.
- K. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.

- L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- N. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- O. UL 183 - Manufactured Wiring Systems; Current Edition, Including All Revisions.
- P. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- Q. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- R. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
- S. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables; Current Edition, Including All Revisions.
- T. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
- U. UL 854 - Service-Entrance Cables; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
 - 3. Notify Architect/Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- C. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.8 FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F (-10 degrees C), unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect/Engineer and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.1 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
 - 1. Exceptions:
 - a. Use manufactured wiring systems for branch circuits where concealed above accessible ceilings for lighting.
 - 1) Exception: Provide single conductor building wire in raceway for circuit homerun from distribution box to panelboard.
- C. Nonmetallic-sheathed cable is not permitted.

2.2 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- D. Comply with NEMA WC 70.
- E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- G. Conductors for Grounding and Bonding: Also comply with Section 26 0526.
- H. Conductors and Cables Installed in Cable Tray: Listed and labeled as suitable for cable tray use.
- I. Conductor Material:
 - 1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.

2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B 787M unless otherwise indicated.
3. Tinned Copper Conductors: Comply with ASTM B33.
- J. Minimum Conductor Size: 12 AWG.
 1. Branch Circuits: 12 AWG.
 - a. Exceptions:
 - 1) 20 A, 120 V circuits longer than 75 feet (23 m): 10 AWG, for voltage drop.
 - 2) 20 A, 120 V circuits longer than 150 feet (46 m): 8 AWG, for voltage drop.
 2. Control Circuits: 14 AWG.
- K. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- L. Conductor Color Coding:
 1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
 2. Color Coding Method: CONFER WITH OWNER TO MATCH EXISTING CONDUCTOR LABELING SYSTEM.
 3. Color Code:
 - a. 240/120 V, 1 Phase, 3 Wire System:
 - 1) Phase A: CONFER WITH OWNER
 - 2) Phase B: CONFER WITH OWNER.
 - 3) Neutral/Grounded: CONFER WITH OWNER.
 - b. Equipment Ground, All Systems: Green.

2.3 SINGLE CONDUCTOR BUILDING WIRE

- A. Manufacturers:
 1. Copper Building Wire:
 - a. General Cable
 - b. The Okonite Company
 - c. Southwire Company: www.southwire.com.
 - d. Superior Essex
- B. Description: Single conductor insulated wire.
- C. Conductor Stranding:
 1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Solid.
 - b. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:

1. Copper Building Wire: Type THHN/THWN-2, except as indicated below.

2.4 UNDERGROUND FEEDER AND BRANCH-CIRCUIT CABLE

A. Manufacturers:

1. Cerro Wire LLC: www.cerrowire.com.
2. Encore Wire Corporation: www.encorewire.com.
3. Southwire Company: www.southwire.com.

B. Description: NFPA 70, Type UF multiple-conductor cable listed and labeled as complying with UL 493, Type UF-B.

C. Provide equipment grounding conductor unless otherwise indicated.

D. Conductor Stranding:

1. Size 10 AWG and Smaller: Solid.
2. Size 8 AWG and Larger: Stranded.

E. Insulation Voltage Rating: 600 V.

2.5 SERVICE ENTRANCE CABLE

A. Manufacturers:

1. Copper Service Entrance Cable:
 - a. Cerro Wire LLC: www.cerrowire.com.
 - b. Encore Wire Corporation: www.encorewire.com.
 - c. Southwire Company: www.southwire.com.

B. Conductor Stranding: Stranded.

C. Insulation Voltage Rating: 600 V.

2.6 MANUFACTURED WIRING SYSTEMS

A. Manufacturers:

1. AFC Cable Systems Inc: www.afcweb.com.
2. RELOC Wiring Solutions, a brand of Acuity Brands, Inc: www.relocwiring.com.
3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us.
4. Electro/Connect, A Philips Group Brand

B. Description: Manufactured wiring assemblies complying with NFPA 70 Article 604, and listed and labeled as complying with UL 183.

C. Provide components necessary to transition between manufactured wiring system and other wiring methods.

D. Branch Circuit Cables:

1. Conductor Stranding (Size 10 AWG and Smaller): Solid.
2. Insulation Voltage Rating: 600 V.
3. Insulation: Type THHN.
4. Provide dedicated neutral conductor for each phase conductor where indicated or required.
5. Grounding: Full-size integral equipment grounding conductor.
 - a. Provide additional isolated/insulated grounding conductor where indicated or required.
 - b. Provide redundant grounding, suitable for general purpose, non-essential electrical systems in non-hazardous patient care areas of health care facilities where indicated or required.
6. Armor: Steel, interlocked tape.

E. Connectors: Keyed and color-coded to prevent interconnection of different voltages.

F. Fixture Leads: Type TFN insulation.

2.7 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Connectors for Grounding and Bonding: Comply with Section 26 0526.
- C. Wiring Connectors for Splices and Taps:
 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
 2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
- D. Wiring Connectors for Terminations:
 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
 2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
 3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
 4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
 5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
 6. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
 7. Conductors for Control Circuits: Use crimped terminals for all connections.

- E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F (105 degrees C) for standard applications and 302 degrees F (150 degrees C) for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
 - 1. Manufacturers:
 - a. 3M: www.3m.com.
 - b. Ideal Industries, Inc: www.idealindustries.com.
 - c. NSI Industries LLC: www.nsiindustries.com.
- H. Mechanical Connectors: Provide bolted type or set-screw type.
 - 1. Manufacturers:
 - a. Burndy: www.burndy.com.
 - b. IlSCO: www.ilSCO.com.
 - c. Thomas & Betts Corporation: www.tnb.com.
- I. Compression Connectors: Provide circumferential type or hex type crimp configuration.
 - 1. Manufacturers:
 - a. Burndy: www.burndy.com.
 - b. IlSCO: www.ilSCO.com.
 - c. Thomas & Betts Corporation: www.tnb.com.
- J. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
 - 1. Manufacturers:
 - a. Burndy: www.burndy.com.
 - b. IlSCO: www.ilSCO.com.
 - c. Thomas & Betts Corporation: www.tnb.com.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as shown on the drawings.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.3 INSTALLATION

A. Circuiting Requirements:

1. Unless dimensioned, circuit routing indicated is diagrammatic.
2. When circuit destination is indicated and routing is not shown, determine exact routing required.
3. Arrange circuiting to minimize splices.
4. Include circuit lengths required to install connected devices within 10 ft (3.0 m) of location shown.
5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are shown as separate, combining them together in a single raceway is permitted, under the following conditions:
 - a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
 - b. Increase size of conductors as required to account for ampacity derating.
 - c. Size raceways, boxes, etc. to accommodate conductors.
8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.

B. Install products in accordance with manufacturer's instructions.

C. Install conductors and cable in a neat and workmanlike manner in accordance with NECA 1.

D. Install underground feeder and branch-circuit cable (Type UF-B) in accordance with NECA 121.

E. Installation in Raceway:

1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
2. Pull all conductors and cables together into raceway at same time.
3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

F. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

- G. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
 - 1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
- H. Terminate cables using suitable fittings.
- I. Install conductors with a minimum of 12 inches (300 mm) of slack at each outlet.
- J. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- K. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- L. Make wiring connections using specified wiring connectors.
 - 1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
 - 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 - 3. Do not remove conductor strands to facilitate insertion into connector.
 - 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminants. Do not use wire brush on plated connector surfaces.
 - 5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- M. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
 - 1. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
 - b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
 - 2. Wet Locations: Use heat shrink tubing.
- N. Insulate ends of spare conductors using vinyl insulating electrical tape.
- O. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
- P. Identify conductors and cables in accordance with Section 26 0553.
- Q. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

- R. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.4 FIELD QUALITY CONTROL

- A. Perform inspection, testing, and adjusting in accordance with Section 01 4000.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
- D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

SECTION 26 0526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground rod electrodes.

1.2 RELATED REQUIREMENTS

- A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2007.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify exact locations of underground metal water service pipe entrances to building.
 - 2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
 - 3. Notify Architect/Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS

- A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.
- B. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- E. Grounding System Resistance:
 - 1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect/Engineer. Precipitation within the previous 48 hours does not constitute normally dry conditions.
 - 2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
- F. Grounding Electrode System:
 - 1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
 - a. Provide continuous grounding electrode conductors without splice or joint.
 - b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.

2. Metal Underground Water Pipe(s):
 - a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet (3.0 m) at an accessible location not more than 5 feet (1.5 m) from the point of entrance to the building.
 - b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
 - c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
3. Metal Building or Structure Frame:
 - a. Provide connection to metal building or structure frame effectively grounded in accordance with NFPA 70.
4. Concrete-Encased Electrode:
 - a. Provide connection to concrete-encased electrode consisting of not less than 20 feet (6.0 m) of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
5. Ground Rod Electrode(s):
 - a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
 - b. Space electrodes not less than 10 feet (3.0 m) from each other and any other ground electrode.
 - c. Where location is not indicated, locate electrode(s) at least 5 feet (1.5 m) outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
6. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
7. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
 - a. Ground Bar Size: 1/4 by 2 by 12 inches (6 by 50 by 300 mm) unless otherwise indicated or required.
 - b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.
 - c. Ground Bar Mounting Height: 18 inches (450 mm) above finished floor unless otherwise indicated.

G. Service-Supplied System Grounding:

1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.

H. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:

1. Provide grounding electrode system for each separate building or structure.
2. Provide equipment grounding conductor routed with supply conductors.
3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.
4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.

I. Separately Derived System Grounding:

1. Separately derived systems include, but are not limited to:
 - a. Transformers (except autotransformers such as buck-boost transformers).
2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.
3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
4. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
5. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

J. Bonding and Equipment Grounding:

1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
 - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
8. Provide bonding for interior metal air ducts.
9. Provide bonding for metal building frame where not used as a grounding electrode.
- K. Communications Systems Grounding and Bonding:
 1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
 2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
 - a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
 - b. Raceway Size: 3/4 inch (21 mm) unless otherwise indicated or required.
 - c. Ground Bar Size: 1/4 by 2 by 12 inches (6 by 50 by 300 mm) unless otherwise indicated or required.

2.2 GROUNDING AND BONDING COMPONENTS

- A. General Requirements:
 1. Provide products listed, classified, and labeled as suitable for the purpose intended.
 2. Provide products listed and labeled as complying with UL 467 where applicable.
- B. Conductors for Grounding and Bonding, in addition to requirements of Section 26 0519:
 1. Use insulated copper conductors unless otherwise indicated.
 - a. Exceptions:
 - 1) Use bare copper conductors where installed underground in direct contact with earth.
 - 2) Use bare copper conductors where directly encased in concrete (not in raceway).
- C. Connectors for Grounding and Bonding:
 1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
 2. Unless otherwise indicated, use exothermic welded connections or compression connectors for underground, concealed and other inaccessible connections.
 - a. Exceptions:
 - 1) Use mechanical connectors for connections to electrodes at ground access wells.

3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
 - a. Exceptions:
 - 1) Use exothermic welded connections for connections to metal building frame.
 4. Manufacturers - Mechanical and Compression Connectors:
 - a. Advanced Lightning Technology (ALT): www.altfab.com.
 - b. Burndy: www.burndy.com.
 - c. Harger Lightning & Grounding: www.harger.com.
 - d. Thomas & Betts Corporation: www.tnb.com.
 5. Manufacturers - Exothermic Welded Connections:
 - a. Burndy: www.burndy.com.
 - b. Cadweld, a brand of Erico International Corporation: www.erico.com.
 - c. ThermOweld, a brand of Continental Industries, Inc: www.thermoweld.com.
- D. Ground Rod Electrodes:
1. Comply with NEMA GR 1.
 2. Material: Copper-bonded (copper-clad) steel.
 3. Size: 3/4 inch (19 mm) diameter by 10 feet (3.0 m) length, unless otherwise indicated.
 4. Manufacturers:
 - a. Advanced Lightning Technology (ALT): www.altfab.com.
 - b. Erico International Corporation: www.erico.com.
 - c. Galvan Industries, Inc: www.galvanelectrical.com.
 - d. Harger Lightning & Grounding: www.harger.com.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as shown on the drawings.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install grounding and bonding system components in a neat and workmanlike manner in accordance with NECA 1.

- C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
 - 1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches (150 mm) below finished grade.
- D. Make grounding and bonding connections using specified connectors.
 - 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
 - 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
 - 3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
 - 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- E. Identify grounding and bonding system components in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

- A. Perform inspection, testing, and adjusting in accordance with Section 01 4000.
- B. Inspect and test in accordance with NETA ATS except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.13.
- D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.
- F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

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**SECTION 26 0529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Support and attachment components for equipment, conduit, cable, boxes, and other electrical work.

1.2 RELATED REQUIREMENTS

- A. Section 26 0534 - Conduit: Additional support and attachment requirements for conduits.
- B. Section 26 0536 - Cable Trays for Electrical Systems: Additional support and attachment requirements for cable tray.
- C. Section 26 0537 - Boxes: Additional support and attachment requirements for boxes.
- D. Section 26 5100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.
- E. Section 26 5600 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.3 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2013.
- D. MFMA-4 - Metal Framing Standards Publication; 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 5B - Strut-Type Channel Raceways and Fittings; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.

4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 5. Notify Architect/Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

1.5 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable building code.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of four times the applied force.
- E. Installer Qualifications for Field-Welding: As specified.
- F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- G. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
 2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 2.5. Include consideration for vibration, equipment operation, and shock loads where applicable.
 4. Do not use products for applications other than as permitted by NFPA 70 and product listing.

5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
 1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 2. Conduit Clamps: Bolted type unless otherwise indicated.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
 1. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com.
 - b. Erico International Corporation: www.erico.com.
 - c. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
 - d. Thomas & Betts Corporation: www.tnb.com.
- D. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
 1. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com.
 - b. Erico International Corporation: www.erico.com.
 - c. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
 - d. Thomas & Betts Corporation: www.tnb.com.
- E. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
 1. Comply with MFMA-4.
 2. Channel (Strut) Used as Raceway (only where specifically indicated): Listed and labeled as complying with UL 5B.
 3. Channel Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
 4. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch (2.66 mm).

5. Minimum Channel Dimensions: 1-5/8 inch (41 mm) width by 13/16 inch (21 mm) height.
6. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com.
 - b. Thomas & Betts Corporation: www.tnb.com.
 - c. Unistrut, a brand of Atkore International Inc: www.unistrut.com.
 - d. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
- F. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
 1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch (13 mm) diameter.
 - b. Busway Supports: 1/2 inch (13 mm) diameter.
 - c. Single Conduit up to 1 inch (27mm) trade size: 1/4 inch (6 mm) diameter.
 - d. Single Conduit larger than 1 inch (27mm) trade size: 3/8 inch (10 mm) diameter.
 - e. Trapeze Support for Multiple Conduits: 3/8 inch (10 mm) diameter.
 - f. Outlet Boxes: 1/4 inch (6 mm) diameter.
 - g. Luminaires: 1/4 inch (6 mm) diameter.
- G. Non-Penetrating Rooftop Supports for Low-Slope Roofs: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
 1. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 2. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
 3. Mounting Height: Provide minimum clearance of 6 inches (150 mm) under supported component to top of roofing.
 4. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com.
 - b. Erico International Corporation: www.erico.com.
 - c. PHP Systems/Design: www.phpsd.com.
 - d. Unistrut, a brand of Atkore International Inc: www.unistrut.com.
- H. Anchors and Fasteners:
 1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
 2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 4. Hollow Masonry: Use toggle bolts.

5. Hollow Stud Walls: Use toggle bolts.
6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
7. Sheet Metal: Use sheet metal screws.
8. Wood: Use wood screws.
9. Plastic and lead anchors are not permitted.
10. Powder-actuated fasteners are not permitted.
11. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Comply with MFMA-4.
 - b. Channel Material: Use galvanized steel.
 - c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install support and attachment components in a neat and workmanlike manner in accordance with NECA 1.
- C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- E. Install support and attachment components for steel conduits in accordance with NECA 101
- F. Unless specifically indicated or approved by Architect/Engineer, do not provide support from suspended ceiling support system or ceiling grid.
- G. Unless specifically indicated or approved by Architect/Engineer, do not provide support from roof deck.
- H. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- I. Equipment Support and Attachment:
 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.

3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch (80 mm) high concrete pad.
 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- J. Conduit Support and Attachment: Also comply with Section 26 0534.
- K. Box Support and Attachment: Also comply with Section 26 0537.
- L. Interior Luminaire Support and Attachment: Also comply with Section 26 5100.
- M. Exterior Luminaire Support and Attachment: Also comply with Section 26 5600.
- N. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- O. Secure fasteners according to manufacturer's recommended torque settings.
- P. Remove temporary supports.
- Q. Identify independent electrical component support wires above accessible ceilings (only where specifically indicated or permitted) with color distinguishable from ceiling support wires in accordance with NFPA 70.
- R. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners.
 5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 6. To Light Steel: Sheet metal screws.
 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes,
 - a. transformers, and other devices on slotted-channel racks attached to substrate by means that meet anchorage requirements.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

**SECTION 26 0534
CONDUIT**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Flexible metal conduit (FMC).
- C. Liquidtight flexible metal conduit (LFMC).
- D. Electrical metallic tubing (EMT).
- E. Rigid polyvinyl chloride (PVC) conduit.
- F. Conduit fittings.
- G. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
 - 1. Includes additional requirements for fittings for grounding and bonding.
- B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2005.
- B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT); 2005.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- D. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2013.
- E. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.
- F. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2013.
- G. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2015.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
- J. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- K. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.
- L. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- M. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- N. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
5. Notify Architect/Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittals procedures.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
1. Under Slab on Grade: Use rigid PVC conduit.
 2. Exterior, Direct-Buried: Use rigid PVC conduit.
 3. Exterior, Embedded Within Concrete: Use rigid PVC conduit.

- 4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
- 5. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit elbows for bends.
- D. Concealed Within Masonry Walls: Use electrical metallic tubing (EMT).
- E. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit or electrical metallic tubing (EMT).
- F. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit.
 - 1. Locations subject to physical damage include, but are not limited to:
 - a. Where exposed below 8 feet (2.4 m).
- G. Exposed, Exterior: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
- H. Connections to Vibrating Equipment:
 - 1. Dry Locations: Use flexible metal conduit.
 - 2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
 - 3. Maximum Length: 6 feet (1.8 m) unless otherwise indicated.
 - 4. Vibrating equipment includes, but is not limited to:
 - a. Transformers.
 - b. Motors.

2.2 CONDUIT REQUIREMENTS

- A. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling a mandrel through them.
- B. Fittings for Grounding and Bonding: Also comply with Section 26 0526.
- C. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
- D. Provide products listed, classified, and labeled as suitable for the purpose intended.
- E. Minimum Conduit Size, Unless Otherwise Indicated:
 - 1. Branch Circuits: 3/4 inch (21 mm) trade size.
 - 2. Branch Circuit Homeruns: 1 inch (27 mm) trade size.
 - 3. Flexible Connections to Luminaires: 1/2 inch (16 mm) trade size.
 - 4. Underground, Interior: 1 inch (27 mm) trade size.
- F. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 - 1. Allied Tube & Conduit: www.alliedeg.com.
 - 2. Republic Conduit: www.republic-conduit.com.
 - 3. Wheatland Tube Company: www.wheatland.com.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- C. Fittings:
 - 1. Manufacturers:
 - a. Bridgeport Fittings Inc: www.bptfittings.com.
 - b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
 - c. Thomas & Betts Corporation: www.tnb.com.
 - 2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Material: Use steel or malleable iron.
 - 4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.4 FLEXIBLE METAL CONDUIT (FMC)

- A. Manufacturers:
 - 1. AFC Cable Systems, Inc: www.afcweb.com.
 - 2. Electri-Flex Company: www.electriflex.com.
 - 3. International Metal Hose: www.metalhose.com.
- B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.
- C. Fittings:
 - 1. Manufacturers:
 - a. Bridgeport Fittings Inc: www.bptfittings.com.
 - b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
 - c. Thomas & Betts Corporation: www.tnb.com.
 - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Material: Use steel or malleable iron.

2.5 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:

1. AFC Cable Systems, Inc: www.afcweb.com.
2. Electri-Flex Company: www.electriflex.com.
3. International Metal Hose: www.metalhose.com.

B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

C. Fittings:

1. Manufacturers:

- a. Bridgeport Fittings Inc: www.bptfittings.com.
- b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
- c. Thomas & Betts Corporation: www.tnb.com.

2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

3. Material: Use steel or malleable iron.

2.6 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:

1. Allied Tube & Conduit: www.alliedeg.com.
2. Republic Conduit: www.republic-conduit.com.
3. Wheatland Tube Company: www.wheatland.com.

B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

C. Fittings:

1. Manufacturers:

- a. Bridgeport Fittings Inc: www.bptfittings.com.
- b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
- c. Thomas & Betts Corporation: www.tnb.com.

2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

3. Material: Use steel or malleable iron.

4. Connectors and Couplings: Use compression (gland) type.

- a. Do not use indenter type connectors and couplings.
- b. Do not use set-screw type connectors and couplings.

5. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.
6. Embedded Within Concrete (where permitted): Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are not acceptable.

2.7 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Manufacturers:

1. Cantex Inc: www.cantexinc.com.
2. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com.
3. JM Eagle: www.jmeagle.com.

B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

C. Fittings:

1. Manufacturer: Same as manufacturer of conduit to be connected.
2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.8 ACCESSORIES

- A. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.
- B. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- C. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force (890 N).
- D. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.
- E. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on drawings.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in a neat and workmanlike manner in accordance with NECA 1.
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.

E. Conduit Routing:

1. Unless dimensioned, conduit routing indicated is diagrammatic.
2. When conduit destination is indicated and routing is not shown, determine exact routing required.
3. Conceal all conduits unless specifically indicated to be exposed.
4. Conduits in the following areas may be exposed, unless otherwise indicated:
 - a. Electrical rooms.
 - b. Mechanical equipment rooms.
 - c. Within joists in areas with no ceiling.
5. Unless otherwise approved, do not route conduits exposed:
 - a. Across floors.
 - b. Across roofs.
 - c. Across top of parapet walls.
 - d. Across building exterior surfaces.
6. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
7. Arrange conduit to maintain adequate headroom, clearances, and access.
8. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
9. Arrange conduit to provide no more than 150 feet (46 m) between pull points.
10. Route conduits above water and drain piping where possible.
11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
12. Maintain minimum clearance of 6 inches (150 mm) between conduits and piping for other systems.
13. Group parallel conduits in the same area together on a common rack.

F. Conduit Support:

1. Secure and support conduits in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
4. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
5. Use conduit clamp to support single conduit from beam clamp or threaded rod.
6. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.

7. Use of wire for support of conduits is not permitted.
 8. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.
- G. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
 2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
 3. Use suitable adapters where required to transition from one type of conduit to another.
 4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
 5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
 6. Where spare conduits stub up through concrete floors and are not terminated in a box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
 7. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
 8. Secure joints and connections to provide maximum mechanical strength and electrical continuity.
- H. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
 2. Make penetrations perpendicular to surfaces unless otherwise indicated.
 3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
 4. Conceal bends for conduit risers emerging above ground.
 5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
 6. Provide suitable modular seal where conduits penetrate exterior wall below grade.
 7. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
 8. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
 9. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.
- I. Underground Installation:
1. Provide trenching and backfilling in accordance with Sections 31 2316 and 31 2323.

2. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Underground, Exterior: 24 inches (610 mm).
 - b. Under Slab on Grade: 12 inches (300 mm) to bottom of slab.
3. Provide underground warning tape in accordance with Section 26 0553 along entire conduit length.
- J. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
 1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
 2. Where conduits are subject to earth movement by settlement or frost.
- K. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
 1. Where conduits pass from outdoors into conditioned interior spaces.
 2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- L. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches (300 mm) at each end.
- M. Provide grounding and bonding in accordance with Section 26 0526.
- N. Identify conduits in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Correct deficiencies and replace damaged or defective conduits.

3.4 CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

3.5 PROTECTION

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION

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**SECTION 26 0537
BOXES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches (1,650 cu cm), including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches (1,650 cu cm).
- C. Underground boxes/enclosures.

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 2726 - Wiring Devices:
 - 1. Wall plates.
 - 2. Floor box service fittings.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
- C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.
- D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013.
- E. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; 2013.
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. SCTE 77 - Specification for Underground Enclosure Integrity; 2013.
- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- K. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- L. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.
- M. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect/Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 BOXES

A. General Requirements:

1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
3. Provide products listed, classified, and labeled as suitable for the purpose intended.
4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

- B. Outlet and Device Boxes Up to 100 cubic inches (1,650 cu cm), Including Those Used as Junction and Pull Boxes:
1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
 2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
 3. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
 4. Use cast aluminum boxes where aluminum rigid metal conduit is used.
 5. Use nonmetallic boxes where exposed rigid PVC conduit is used.
 6. Use suitable concrete type boxes where flush-mounted in concrete.
 7. Use suitable masonry type boxes where flush-mounted in masonry walls.
 8. Use raised covers suitable for the type of wall construction and device configuration where required.
 9. Use shallow boxes where required by the type of wall construction.
 10. Do not use "through-wall" boxes designed for access from both sides of wall.
 11. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
 12. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
 13. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.
 14. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
 15. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes.
 16. Minimum Box Size, Unless Otherwise Indicated:
 - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
 - b. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
 17. Wall Plates: Comply with Section 26 2726.
 18. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com.
 - b. Hubbell Incorporated; Bell Products: www.hubbell-rtb.com.
 - c. Hubbell Incorporated; RACO Products: www.hubbell-rtb.com.
 - d. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
 - e. Thomas & Betts Corporation: www.tnb.com.

- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
 - 1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 - 2. NEMA 250 Environment Type, Unless Otherwise Indicated:
 - a. Indoor Clean, Dry Locations: Type 12, painted steel.
 - b. Outdoor Locations: Type 3R, painted steel.
 - 3. Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
- D. Underground Boxes/Enclosures:
 - 1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
 - 2. Size: As indicated on drawings.
 - 3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches (300 mm).
 - 4. Provide logo on cover to indicate type of service.
 - 5. Applications:
 - a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77, Tier 8 load rating.
 - b. Parking Lots, in Areas Subject Only To Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77, Tier 15 load rating.
 - c. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
 - 6. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
 - a. Manufacturers:
 - 1) Highline Products, a subsidiary of MacLean Power Systems: www.highlineproducts.com.
 - 2) Hubbell Incorporated; Quazite Products: www.hubbellpowersystems.com.
 - 3) Oldcastle Precast, Inc: www.oldcastleprecast.com.
 - b. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on drawings.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide separate boxes for emergency power and normal power systems.
- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- H. Box Locations:
 - 1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 3100 as required where approved by the Architect.
 - 2. Unless dimensioned, box locations indicated are approximate.
 - 3. Locate boxes as required for devices installed under other sections or by others.
 - a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 2726.
 - b. Communications Systems Outlets: Comply with Section 27 1005.
 - 4. Locate boxes so that wall plates do not span different building finishes.
 - 5. Locate boxes so that wall plates do not cross masonry joints.
 - 6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
 - 7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches (150 mm) horizontal separation unless otherwise indicated.
 - 8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches (610 mm) horizontal separation.
 - 9. Fire-Resistance-Rated Walls: Install flush-mounted boxes such that the required fire-resistance will not be reduced.
 - 10. Locate junction and pull boxes in the following areas, unless otherwise indicated:
 - a. Concealed above accessible suspended ceilings.
 - b. Within joists in areas with no ceiling.
 - c. Electrical rooms.
 - d. Mechanical equipment rooms.
- I. Box Supports:
 - 1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.

2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
- J. Install boxes plumb and level.
- K. Flush-Mounted Boxes:
 1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch (6 mm) or does not project beyond finished surface.
 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
 3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch (3 mm) at the edge of the box.
- L. Install boxes as required to preserve insulation integrity.
- M. Underground Boxes/Enclosures:
 1. Install enclosure on gravel base, minimum 6 inches (150 mm) deep.
 2. Flush-mount enclosures located in concrete or paved areas.
 3. Mount enclosures located in landscaped areas with top at 1 inch (25 mm) above finished grade.
 4. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.
- N. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- O. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.
- P. Close unused box openings.
- Q. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- R. Provide grounding and bonding in accordance with Section 26 0526.
- S. Identify boxes in accordance with Section 26 0553.

3.3 CLEANING

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.4 PROTECTION

- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

SECTION 26 0553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Underground warning tape.
- F. Warning signs and labels.

1.2 RELATED REQUIREMENTS

- A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- B. Section 26 2726 - Wiring Devices: Device and wallplate finishes; factory pre-marked wallplates.

1.3 REFERENCE STANDARDS

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2011.
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 70E - Standard for Electrical Safety in the Workplace; 2015.
- E. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
 - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
 - 2. Do not install identification products until final surface finishes and painting are complete.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittals procedures.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.7 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.1 IDENTIFICATION REQUIREMENTS

- A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.
- B. Identification for Equipment:
 - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
 - a. Panelboards:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location.
 - 4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
 - 5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
 - 6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
 - b. Transformers:
 - 1) Identify kVA rating.
 - 2) Identify voltage and phase for primary and secondary.
 - 3) Identify power source and circuit number. Include location.
 - 4) Identify load(s) served. Include location.
 - c. Enclosed switches, circuit breakers, and motor controllers:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location.
 - 3) Identify load(s) served. Include location.
 - d. Enclosed Contactors:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify configuration, e.g., E.O.E.H. (electrically operated, electrically held) or (a) E.O.M.H. (electrically operated, mechanically held).
 - 4) Identify coil voltage.
 - 5) Identify load(s) and associated circuits controlled. Include location.

2. Service Equipment:
 - a. Use identification nameplate to identify each service disconnecting means.
 - b. Use identification nameplate at each piece of service equipment to identify the available fault current and the date calculations were performed.
3. Use identification nameplate to identify equipment utilizing series ratings, where permitted, in accordance with NFPA 70.
4. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
5. Use identification label on inside of door at each fused switch to identify required NEMA fuse class and size.
6. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70, including but not limited to the following.
 - a. Service equipment.
7. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
 - a. Minimum Size: 3.5 by 5 inches (89 mm by 127 mm).
 - b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
 - c. Service Equipment: Include the following information in accordance with NFPA 70.
 - 1) Nominal system voltage.
 - 2) Available fault current.
 - 3) Clearing time of service overcurrent protective device(s).
 - 4) Date label applied.
8. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
 - a. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data:
 - 1) Include orange header that reads "WARNING" where calculated incident energy is less than 40 calories per square cm.
 - 2) Include red header that reads "DANGER" where calculated incident energy is 40 calories per square cm or greater.
 - 3) Include the text "Arc Flash and Shock Hazard; Appropriate PPE Required" or approved equivalent.

- 4) Include the following information:
 - (a) Arc flash protection boundary.
 - (b) Incident energy.
 - (c) Hazard/risk category.
 - (d) PPE (personnel protective equipment) requirements.
 - (e) Nominal voltage.
 - (f) Shock hazard condition.
 - (g) Limited approach boundary.
 - (h) Restricted approach boundary.
 - (i) Prohibited approach boundary.
 - (j) Equipment identification.
 - (k) Date calculations were performed.
 9. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.
 10. Use warning labels to identify electrical hazards for equipment, compartments, and enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
 11. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or approved equivalent.
- C. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Confer with owner to match existing conductor labeling system.
 2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
- D. Identification for Devices:
1. Identification for Communications Devices: Comply with Section 27 1005.
 2. Wiring Device and Wallplate Finishes: Comply with Section 26 2726.
 3. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
 - a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.
 4. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.
 5. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

E. Identification for Luminaires:

1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

2.2 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:

1. Manufacturers:

- a. Brimar Industries, Inc: www.brimar.com.
- b. Kolbi Pipe Marker Co: www.kolbipipemarkers.com.
- c. Seton Identification Products: www.seton.com.

2. Materials:

- a. Indoor Clean, Dry Locations: Use plastic nameplates.
- b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.

3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically

- a. non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch (1.6 mm); engraved text.
- b. Exception: Provide minimum thickness of 1/8 inch (3 mm) when any dimension is greater than 4 inches (100 mm).

4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.

5. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.

6. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch (25 mm) high; Four, located at corners for larger sizes.

B. Identification Labels:

1. Manufacturers:

- a. Brady Corporation: www.bradyid.com.
- b. Brother International Corporation: www.brother-usa.com.
- c. Panduit Corp: www.panduit.com.

2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.

3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:

1. Minimum Size: 1 inch (25 mm) by 2.5 inches (64 mm).

2. Legend:

- a. Equipment designation or other approved description.

3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
 - a. Equipment Designation: 1/2 inch (13 mm).
5. Color:
 - a. Normal Power System: White text on black background.

2.3 WIRE AND CABLE MARKERS

- A. Manufacturers:
 1. Brady Corporation: www.bradyid.com.
 2. HellermannTyton: www.hellermannityton.com.
 3. Panduit Corp: www.panduit.com.
- B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- D. Legend: Power source and circuit number or other designation indicated.
- E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
 1. Do not use handwritten text.
- F. Minimum Text Height: 1/8 inch (3 mm).
- G. Color: Black text on white background unless otherwise indicated.

2.4 VOLTAGE MARKERS

- A. Manufacturers:
 1. Brady Corporation: www.bradyid.com.
 2. Brimar Industries, Inc: www.brimar.com.
 3. Seton Identification Products: www.seton.com.
- B. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.
- C. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
- D. Minimum Size:
 1. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
 2. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches (29 by 110 mm).
 3. Markers for Junction Boxes: 1/2 by 2 1/4 inches (13 by 57 mm).
- E. Legend:
 1. Markers for Voltage Identification: Highest voltage present.
 2. Markers for System Identification:

F. Color: Black text on orange background unless otherwise indicated.

2.5 UNDERGROUND WARNING TAPE

A. Manufacturers:

1. Brady Corporation: www.bradyid.com.
2. Brimar Industries, Inc: www.brimar.com.
3. Seton Identification Products: www.seton.com.

B. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.

C. Non-detectable Type Tape: 6 inches (152 mm) wide, with minimum thickness of 4 mil (0.1 mm).

D. Legend: Type of service, continuously repeated over full length of tape.

E. Color:

2.6 WARNING SIGNS AND LABELS

A. Manufacturers:

1. Brimar Industries, Inc: www.brimar.com.
2. Clarion Safety Systems, LLC: www.clarionsafety.com.
3. Seton Identification Products: www.seton.com.

B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

C. Warning Signs:

1. Materials:
 - a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
 - b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
3. Minimum Size: 7 by 10 inches (178 by 254 mm) unless otherwise indicated.

D. Warning Labels:

1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or
 - a. self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
 - b. Do not use labels designed to be completed using handwritten text.
 - c. Provide polyester overlamine to protect handwritten text.
2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
3. Minimum Size: 2 by 4 inches (51 mm by 102 mm) unless otherwise indicated.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
 - 1. Surface-Mounted Equipment: Enclosure front.
 - 2. Flush-Mounted Equipment: Inside of equipment door.
 - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
 - 4. Elevated Equipment: Legible from the floor or working platform.
 - 5. Branch Devices: Adjacent to device.
 - 6. Interior Components: Legible from the point of access.
 - 7. Conduits: Legible from the floor.
 - 8. Boxes: Outside face of cover.
 - 9. Conductors and Cables: Legible from the point of access.
 - 10. Devices: Outside face of cover.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
 - 1. Do not use adhesives on exterior surfaces except where substrate cannot be penetrated.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Install underground warning tape above buried lines with one tape per trench at 3 inches (75 mm) below finished grade.
- G. Secure rigid signs using stainless steel screws.
- H. Mark all handwritten text, where permitted, to be neat and legible.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

**SECTION 26 0583
WIRING CONNECTIONS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical connections to equipment.

1.2 RELATED REQUIREMENTS

- A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 26 0537 - Boxes
- C. Section 26 2726 - Wiring Devices.
- D. Section 26 2816.16 - Enclosed Switches.

1.3 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2015).
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2016.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
 - 1. Colors: Conform to NEMA WD 1.
 - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
 - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
- B. Disconnect Switches: As specified in Section 26 2816.16 and in individual equipment sections.
- C. Wiring Devices: As specified in Section 26 2726.
- D. Boxes: As specified in Section 26 0537.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION

**SECTION 26 0923
LIGHTING CONTROL DEVICES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Occupancy sensors.

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems
- C. Section 26 0533.16 - Boxes for Electrical Systems.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 2726 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
- C. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2016.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
 - 3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
 - 4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
 - 5. Notify Architect/Engineer of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

- B. Pre-Wire Meeting: Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "LIGHTING CONTROLS - GENERAL REQUIREMENTS", sensor locations to be reviewed in accordance with layout provided by Lighting Control Manufacturer. Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require a deviation from locations indicated.
- C. Sequencing:
 - 1. Do not install lighting control devices until final surface finishes and painting are complete.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
 - 1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
- C. Shop Drawings:
 - 1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
 - 2. Provide detailed wiring diagrams for each sequence of operation scheme used in the plans.
- D. Field Quality Control Reports.
- E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Operation and Maintenance Data: Include detailed information on device programming and setup.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
- H. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.8 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for all occupancy sensors.

PART 2 PRODUCTS

2.1 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.
- C. Products for Switching of Electronic Ballasts/Drivers: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

2.2 OCCUPANCY SENSORS

- A. All Occupancy Sensors:
 - 1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
 - 2. Sensor Technology:
 - a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.
 - b. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
 - 3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
 - 4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
 - 5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
 - 6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.
 - 7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
 - 8. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, LED lighting, and fractional motor loads, with no minimum load requirements.

9. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on drawings.
- B. Ceiling Mounted Occupancy Sensors:
 1. All Ceiling Mounted Occupancy Sensors:
 - a. Description: Low profile occupancy sensors designed for ceiling installation.
 - b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
 - c. Provide field selectable setting for disabling LED motion detector visual indicator.
 - d. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
 - e. Finish: White unless otherwise indicated.
 2. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
- C. Power Packs for Low Voltage Occupancy Sensors:
 1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
 2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
 3. Input Supply Voltage: Dual rated for 120/277 V ac.
 4. Load Rating: As required to control the load indicated on drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
- F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.
- G. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of lighting control devices provided under this section.
- C. Install lighting control devices in accordance with manufacturer's instructions.
- D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- E. Install lighting control devices plumb and level and held securely in place.
- F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 2726.
- G. Provide required supports in accordance with Section 26 0529.
- H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- I. Identify lighting control devices in accordance with Section 26 0553.
- J. Occupancy Sensor Locations:
 - 1. Location Adjustments: Do not make adjustments to locations without obtaining approval from the Architect/Engineer.
 - 2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 6 feet (1.8 m) from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect each lighting control device for damage and defects.
- C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
- D. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.5 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect/Engineer.
- C. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

3.6 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.7 COMMISSIONING

- A. See Section 01 9113 - General Commissioning Requirements for commissioning requirements.

3.8 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of lighting control devices to Architect/Engineer, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of the installed lighting control devices.
 - 4. Location: At project site.

END OF SECTION

**SECTION 26 1200
MEDIUM-VOLTAGE TRANSFORMERS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Liquid-filled pad-mounted distribution transformers.

1.2 RELATED REQUIREMENTS

- A. Section 26 0529 - Hangers and Supports for Electrical Systems.

1.3 REFERENCE STANDARDS

- A. IEEE C57.12.00 - IEEE Standard for General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers; 2021.
- B. IEEE C57.12.01 - IEEE Standard for General Requirements for Dry-Type Distribution and Power Transformers; 2020.
- C. IEEE C57.12.90 - IEEE Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers; 2021.
- D. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.
- E. IEEE C57.111 - IEEE Standard Guide for Acceptance of Silicone Insulating Fluid and Its Maintenance in Transformers; 1995 (Reaffirmed 2009).
- F. IEEE C57.121 - IEEE Guide for Acceptance and Maintenance of Less-Flammable Hydrocarbon Fluid in Transformers; 1998 (Reaffirmed 2009).
- G. NEMA TP 80049 - Safety Labels for Pad-Mounted Switchgear and Transformers Sited in Public Areas; 2025.
- H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate electrical characteristics and connection requirements, outline dimensions, connection and support points, weight, specified ratings and materials.
- C. Product Data: Provide electrical characteristics and connection requirements, standard model design tests, and options.
- D. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.
- E. Manufacturer's Installation Instructions.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- G. Manufacturer's Field Reports: Indicate activities on site, final adjustments and overcurrent protective device coordination curves, adverse findings, and recommendations.
- H. Project Record Documents: Include copy of manufacturer's certified drawings.

- I. Maintenance Data: Include maintenance instructions for cleaning methods; cleaning materials recommended ; procedures for sampling and maintaining fluid.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles (160 km) of Project.
- C. Products: Listed, classified, and labeled as suitable for the purpose intended.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Cooper Power Systems, a division of Eaton Corporation: www.cooperindustries.com/#sle.
- B. Hammond Transformers.
- C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
- D. Siemens Industry, Inc: www.usa.siemens.com/#sle.
- E. ABB

2.2 LIQUID-FILLED TRANSFORMERS

- A. Liquid-Filled Transformers: IEEE C57.12.00, single phase, pad-mounted, self-cooled transformer unit.
- B. Cooling and Temperature Rise; IEEE C57.12.00; Class OA. 65 degrees C, self-cooled.
- C. Insulating Liquid: Oil.

2.3 SERVICE CONDITIONS

- A. Meet requirements for usual service conditions described in {rs\#1} and for the specified unusual service conditions.

2.4 RATINGS

- A. Capacity, Primary Voltage, and Secondary Voltage: As indicated in the drawings.
- B. Impedance: 5.75 percent maximum.
- C. Basic Impulse Level: 60 kV.

2.5 ACCESSORIES

- A. Accessories: IEEE C57.12.00 standard accessories and IEEE C57.12.00 standard accessories.
- B. Primary Terminations: Bushing wells to IEEE 386; provide three for radial feed. Include bushings for insulated loadb

- C. Primary Overcurrent Protection: Bayonet-type liquid-immersed expulsion fuses.
- D. Secondary Terminations: Spade lugs.

2.6 FABRICATION

- A. Conform to the requirements of IEEE C57.12.28.

2.7 FACTORY FINISHING

- A. Clean surfaces before applying paint.
- B. Apply corrosion-resisting primer to all surfaces.
- C. Apply finish coat of baked enamel paint to 2 mils (0.5 mm) thick.
- D. Finish Color: Manufacturer's standard light gray finish.

2.8 SOURCE QUALITY CONTROL

- A. Provide factory tests to IEEE C57.12.90 and IEEE C57.12.00. Include the routine tests as defined in the standards and the following other tests:
 - 1. Impedance voltage and load loss.
 - 2. Dielectric tests.
 - 3. Audible sound level.
- B. Test insulating liquid samples in accordance with IEEE C57.111.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that support pads provided under Section 03 3000 are ready to receive products.

3.2 INSTALLATION

- A. Provide required support and attachment in accordance with Section 26 0529.
- B. Install plumb and level.
- C. Install safety labels to NEMA TP 80049.

3.3 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.2. Tests listed as optional are not required.
 - 1. Liquid-Filled Transformers:
 - a. Test dew point of tank gases.
 - b. Perform sweep frequency response analysis tests.
 - c. Perform leakage reactance three phase equivalent and per phase tests.

- d. If core ground strap is accessible, remove and measure core insulation resistance at 500 volts dc.
- e. Measure insulating liquid's specific gravity and dissipation factor or power factor.

3.4 ADJUSTING

- A. Adjust primary taps so that secondary voltage is above and within 2 percent of rated voltage.

END OF SECTION

SECTION 26 2100
LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical service requirements.

1.2 RELATED REQUIREMENTS

- A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0534 - Conduit.
- E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.3 DEFINITIONS

- A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

1.4 REFERENCE STANDARDS

- A. IEEE C2 - National Electrical Safety Code; 2012.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

1.6 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. IEEE C2 (National Electrical Safety Code).
 - 2. NFPA 70 (National Electrical Code).
 - 3. The requirements of the Utility Company.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- B. Store products indoors in a clean, dry space having a uniform temperature to prevent condensation (including outdoor rated products which are not weatherproof until completely and properly installed). Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle products carefully to avoid damage to internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 ELECTRICAL SERVICE REQUIREMENTS

- A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.
- B. Electrical Service Characteristics: As indicated on drawings.
- C. Products Furnished by Contractor: Comply with Utility Company requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on drawings.
- B. Verify that ratings and configurations of service entrance equipment are consistent with the indicated requirements.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Verify and mark locations of existing underground utilities.

3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and Utility Company requirements.
- B. Perform work in a neat and workmanlike manner in accordance with NECA 1.
- C. Arrange equipment to provide minimum clearances and required maintenance access.
- D. Provide required support and attachment components in accordance with Section 26 0529.
- E. Provide grounding and bonding for service entrance equipment in accordance with Section 26 0526.
- F. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 26 0553.

3.4 PROTECTION

- A. Protect installed equipment from subsequent construction operations.

END OF SECTION

SECTION 26 2416 PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Power distribution panelboards.
- B. Lighting and appliance panelboards.
- C. Overcurrent protective devices for panelboards.

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 0573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

1.3 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2015.
- D. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- E. NEMA PB 1 - Panelboards; 2011.
- F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000V or Less; 2023.
- G. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- K. UL 67 - Panelboards; Current Edition, Including All Revisions.
- L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect/Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
 2. Include wiring diagrams showing all factory and field connections.
 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
- D. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 1 as routine tests.
- E. Field Quality Control Test Reports.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- H. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 01 6000 - Product Requirements, for additional provisions.
 2. Panelboard Keys: Two of each different key.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperature within the following limits during and after installation of panelboards:
 - 1. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
- B. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet (2,000 m).
 - 2. Ambient Temperature:
 - a. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).
- C. Short Circuit Current Rating: as indicated in the drawings.
- D. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- E. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- F. Bussing: Sized in accordance with UL 67 temperature rise requirements.
 - 1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
 - 2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
- G. Conductor Terminations: Suitable for use with the conductors to be installed.

- H. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 12.
 - b. Outdoor Locations: Type 3R.
 - 2. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 - 3. Fronts:
 - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
 - b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
 - c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
 - 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- I. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- J. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.
- K. Load centers are not acceptable.

2.3 POWER DISTRIBUTION PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
 - 1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
 - 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
 - 1. Phase and Neutral Bus Material: Copper.
 - 2. Ground Bus Material: Copper.
- D. Circuit Breakers:
 - 1. Provide bolt-on type.
 - 2. Provide thermal magnetic circuit breakers for circuit breaker frame sizes less than 150 amperes.
 - 3. Provide electronic trip circuit breakers for circuit breaker frame sizes 150 amperes and above.
- E. Enclosures:
 - 1. Provide surface-mounted enclosures unless otherwise indicated.

2. Fronts: Provide trims to cover access to load terminals, wiring gutters, and other live parts, with exposed access to overcurrent protective device handles.

2.4 LIGHTING AND APPLIANCE PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated.
- B. Conductor Terminations:
 1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
 1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
 2. Phase and Neutral Bus Material: Copper.
 3. Ground Bus Material: Copper.
- D. Circuit Breakers: Thermal magnetic bolt-on type.
- E. Enclosures:
 1. Provide surface-mounted enclosures.
 2. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 3. Provide clear plastic circuit directory holder mounted on inside of door.

2.5 OVERCURRENT PROTECTIVE DEVICES

- A. Molded Case Circuit Breakers:
 1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489 and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
 2. Interrupting Capacity:
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - 2) 14,000 rms symmetrical amperes at 480 VAC.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
 3. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.

5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units. Provide for all breakers 225A and larger.
6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
7. Provide listed switching duty rated circuit breakers with SWD marking for all lighting circuits.
8. Do not use tandem circuit breakers.
9. Do not use handle ties in lieu of multi-pole circuit breakers.

2.6 SOURCE QUALITY CONTROL

- A. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- B. Verify that mounting surfaces are ready to receive panelboards.
- C. Coordinate the panelboard and the surface to be mounted on or in.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required supports in accordance with Section 26 0529.
- F. Install panelboards plumb.
- G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches (2000 mm) above the floor or working platform.
- I. Provide minimum of six spare 1 inch (27 mm) trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- J. Provide grounding and bonding in accordance with Section 26 0526.
- K. Install all field-installed branch devices, components, and accessories.
- L. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- M. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section 26 0573.

- N. Provide filler plates to cover unused spaces in panelboards.
- O. Identify panelboards in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 250 amperes. Tests listed as optional are not required.
- D. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.
- C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.5 CLEANING

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

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**SECTION 26 2726
WIRING DEVICES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall switches.
- B. Receptacles.
- C. Wall plates.

1.2 RELATED REQUIREMENTS

- A. Section 26 0533.16 - Boxes for Electrical Systems.
- B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2017g (Validated 2023).
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2015).
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2016.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
- K. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
- L. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.
- M. UL 1917 - Solid-State Fan Speed Controls; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
 - 3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.

4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
 5. Notify Architect/Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.
- B. Sequencing:
1. Do not install wiring devices until final surface finishes and painting are complete.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
- C. Field Quality Control Test Reports.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Operation and Maintenance Data:
 1. GFCI Receptacles: Include information on status indicators.
- F. Project Record Documents: Record actual installed locations of wiring devices.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 01 6000 - Product Requirements, for additional provisions.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Products: Listed, classified, and labeled as suitable for the purpose intended.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.1 WIRING DEVICE APPLICATIONS

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
- B. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.

- C. Provide tamper resistant receptacles for receptacles installed within the showerhouse.
- D. Provide GFCI protection for receptacles installed within 6 feet (1.8 m) of sinks.
- E. Provide GFCI protection for receptacles serving electric drinking fountains.

2.2 WIRING DEVICE FINISHES

- A. Provide wiring device finishes as described below unless otherwise indicated.
- B. Wiring Devices, Unless Otherwise Indicated: Gray with gray nylon wall plate.
- C. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.
- D. Wiring Devices Installed in Wet or Damp Locations: Gray with specified weatherproof cover.

2.3 WALL SWITCHES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com/#sle.
 - 2. Cooper Wiring Devices
 - 3. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
 - 4. Lutron
 - 5. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
- B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable FS W-S-896; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.4 RECEPTACLES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com/#sle.
 - 2. Cooper Wiring Devices.
 - 3. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
 - 4. Lutron Electronics Company, Inc: www.lutron.com/sle.
 - 5. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
- B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
 - 2. NEMA configurations specified are according to NEMA WD 6.

C. Convenience Receptacles:

1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
2. Tamper Resistant and Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.

D. GFCI Receptacles:

1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
 - a. Provide test and reset buttons of same color as device.
2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
3. Tamper Resistant and Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.

2.5 WALL PLATES

A. Manufacturers:

1. Hubbell Incorporated: www.hubbell-wiring.com/#sle.
2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
3. Lutron Electronics Company, Inc: www.lutron.com/sle.
4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
5. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer.

B. Wall Plates: Comply with UL 514D.

1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
2. Size: Standard.
3. Screws: Metal with slotted heads finished to match wall plate finish.

C. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.

D. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.

E. Premarked Wall Plates: Factory labeled as indicated; hot stamped for nylon wall plates and engraved for metal wall plates.

F. Weatherproof Covers for Wet or Damp Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- B. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- C. Verify that final surface finishes are complete, including painting.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of wiring devices provided under this section.
 - 1. Mounting Heights: Unless otherwise indicated, as follows:
 - a. Wall Switches: 48 inches (1200 mm) above finished floor.
 - b. Wall Dimmers: 48 inches (1200 mm) above finished floor.
 - c. Receptacles: 18 inches (450 mm) above finished floor or 6 inches (150 mm) above counter.
 - 2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
 - 3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
 - 4. Locate wall switches on strike side of door with edge of wall plate 3 inches (80 mm) from edge of door frame. Where locations are indicated otherwise, notify Architect/Engineer to obtain direction prior to proceeding with work.
 - 5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.
- C. Install wiring devices in accordance with manufacturer's instructions.
- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- E. Where required, connect wiring devices using pigtails not less than 6 inches (150 mm) long. Do not connect more than one conductor to wiring device terminals.
- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
- I. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- J. Install wall switches with OFF position down.
- K. Install vertically mounted receptacles with grounding pole on bottom and horizontally mounted receptacles with grounding pole on left.
- L. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- M. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
- N. Identify wiring devices in accordance with Section 26 0553.

3.4 FIELD QUALITY CONTROL

- A. Inspect each wiring device for damage and defects.
- B. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.
- C. Test each receptacle to verify operation and proper polarity.
- D. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- E. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.5 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.6 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

SECTION 26 2813 FUSES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fuses.

1.2 RELATED REQUIREMENTS

- A. Section 26 2816.16 - Enclosed Switches: Fusible switches.

1.3 REFERENCE STANDARDS

- A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.
- D. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses; Current Edition, Including All Revisions.
- E. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
 - 2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
 - 3. Notify Architect/Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com.

B. Littelfuse, Inc: www.littelfuse.com.

C. Mersen: ep-us.mersen.com.

2.2 APPLICATIONS

A. Individual Motor Branch Circuits: Class RK5, time-delay.

2.3 FUSES

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.

C. Provide fuses of the same type, rating, and manufacturer within the same switch.

D. Comply with UL 248-1.

E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.

F. Voltage Rating: Suitable for circuit voltage.

G. Class R Fuses: Comply with UL 248-12.

1. Class RK5, Time-Delay Fuses:

H. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

I. Provide the following accessories where indicated or where required to complete installation:

1. Fuseholders: Compatible with indicated fuses.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

B. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Do not install fuses until circuits are ready to be energized.

B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION

**SECTION 26 2816.16
ENCLOSED SWITCHES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Enclosed safety switches.

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 2813 - Fuses.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- C. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013 (Reaffirmed 2023).
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 4. Notify Architect/Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 - 1. Include dimensioned plan and elevation views of enclosed switches and adjacent equipment with all required clearances indicated.
 - 2. Include wiring diagrams showing all factory and field connections.
- D. Field Quality Control Test Reports.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- F. Project Record Documents: Record actual locations of enclosed switches.
- G. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperature between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C) during and after installation of enclosed switches.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Eaton Corporation: www.eaton.com.
- B. Schneider Electric; Square D Products: www.schneider-electric.us.
- C. Siemens Industry, Inc: www.usa.siemens.com.
- D. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 ENCLOSED SAFETY SWITCHES

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet (2,000 m).
 - 2. Ambient Temperature: Between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C).
- D. Horsepower Rating: Suitable for connected load.
- E. Voltage Rating: Suitable for circuit voltage.
- F. Short Circuit Current Rating:
 - 1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 0573.
- G. Provide with switch blade contact position that is visible when the cover is open.
- H. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
 - 1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
- I. Conductor Terminations: Suitable for use with the conductors to be installed.
- J. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- K. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 12 .
 - b. Outdoor Locations: Type 3R.
- L. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

- M. Heavy Duty Switches:
 - 1. Comply with NEMA BS 31047.
 - 2. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
 - a. Provide means for locking handle in the ON position.
- N. Provide the following features and accessories where indicated or where required to complete installation:
 - 1. Hubs: As required for environment type; sized to accept conduits to be installed.
 - 2. Auxiliary Switch: SPDT switch suitable for connection to system indicated, with auxiliary contact operation before switch blades open and after switch blades close.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed safety switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required supports in accordance with Section 26 0529.
- E. Install enclosed switches plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches (2000 mm) above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 26 0526.
- H. Provide fuses complying with Section 26 2813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.
- I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- J. Identify enclosed switches in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

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**SECTION 26 3100
PHOTOVOLTAIC COLLECTORS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Photovoltaic system requirements.
- B. Photovoltaic modules.
- C. Photovoltaic module mounting system.
- D. Photovoltaic inverters.
- E. Charge controllers.
- F. Monitoring system.

1.2 RELATED REQUIREMENTS

- A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 2200 - LOW-VOLTAGE TRANSFORMERS: Isolation transformers not integral to inverters.
- F. Section 26 2816.16 - Enclosed Switches.
- G. Section 26 4300 - Surge Protective Devices.

1.3 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. IEC 61215-1 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 1: Test Requirements; 2021, with Corrigendum.
- C. IEC 61215-1-1 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 1-1: Special Requirements for Testing of Crystalline Silicon Photovoltaic (PV) Modules; 2021.
- D. IEC 61215-1-2 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 1-2: Special Requirements for Testing of Thin-Film Cadmium Telluride (CdTe) Based Photovoltaic (PV) Modules; 2021, with Amendment (2022).
- E. IEC 61215-1-3 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 1-3: Special Requirements for Testing of Thin-Film Amorphous Silicon Based Photovoltaic (PV) Modules; 2021, with Amendment (2022).
- F. IEC 61215-1-4 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 1-4: Special Requirements for Testing of Thin-Film Cu(In,Ga)(S,Se)₂ Based Photovoltaic (PV) Modules; 2021, with Amendment (2022).

- G. IEC 61215-2 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 2: Test Procedures; 2021.
- H. IEEE 1547 - IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces; 2018, with Amendment (2020).
- I. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- J. NECA 412 - Standard for Installing and Maintaining Photovoltaic (PV) Power Systems; 2012.
- K. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. UL 489B - Outline of Investigation for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures for Use with Photovoltaic (PV) Systems; Current Edition, Including All Revisions.
- N. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.
- O. UL 1699B - Outline of Investigation for Photovoltaic (PV) DC Arc-Fault Circuit Protection; Current Edition; Current Edition, Including All Revisions.
- P. UL 1703 - Flat Plate Photovoltaic Modules and Panels; Current Edition, Including All Revisions.
- Q. UL 1741 - Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources; Current Edition, Including All Revisions.
- R. UL 2579 - Low-Voltage Fuses - Fuses for Photovoltaic Systems; Current Edition, Including All Revisions.
- S. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment or other potential obstructions within the spaces dedicated for photovoltaic system components.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Roof-Mounted Arrays: Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
 - 4. Notify Architect/Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Preinstallation Meeting: Convene one week prior to commencing work of this section; require attendance of all affected installers. Include adequate instruction on the electrical hazards associated with photovoltaic systems and appropriate safety procedures to be followed.
- C. Rebates and Incentives: Prepare and submit documentation as required for Owner to secure funds from available federal, state, and utility company rebate and incentive programs. Notify Owner of any time constraints affecting program qualification.

D. Utility Interconnection:

1. Prepare and submit documentation as required for securing utility interconnection agreement between Owner and Utility Company.
 - a. Include copies of documentation with submittals.
2. Preinstallation Meeting: Convene one week prior to commencing work of this section to review interconnection requirements and details with Utility Company representative.
3. Coordinate with Utility Company to provide utility metering suitable for system requirements.
4. Arrange for inspections and secure permits necessary to obtain Utility Company approval of system.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, attachment locations and details, and proposed size, type, and routing of conduits and cables. Include system interconnection schematic diagrams showing all factory and field connections.
 1. Include proposed locations of roof penetrations and proposed methods for sealing.
- C. Design Data:
 1. Include structural calculations, certified by structural engineer, for equipment and mounting system.
 2. Include electrical calculations for array and associated equipment other than the basis of design products and configuration.
- D. Certify that products of this section meet or exceed specified requirements.
- E. Certify that work of this section does not void roof warranty.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.
- G. Manufacturer's detailed field testing procedures.
- H. Manufacturer's detailed startup procedures.
- I. Utility interconnection documentation.
- J. Source quality control test reports.
- K. Field quality control test reports.
 1. Include manufacturer's field reports.
- L. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
 1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.
- M. Maintenance contracts.
- N. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.

- O. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.

1.6 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with Utility Company requirements for interconnection.
- C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum Five years documented experience. Tier 1 Manufacture per the latest list by Bloomberg.
- E. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience with photovoltaic systems of similar size, type, and complexity.
 - 1. Licensed in the State in which the Project is located to install photovoltaic systems.
 - 2. Manufacturer's authorized installer.
 - 3. Supervisor: North American Board of Certified Energy Practitioners (NABCEP) certified PV Installer or three years experience supervising the installation of photovoltaic systems.
 - 4. Installer Personnel: At least 2 years of experience installing photovoltaic systems.
- F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.8 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Specified warranties indicate minimum requirements. Provide additional warranties or extended warranty periods where required to qualify for rebate and incentive programs.
- C. Photovoltaic Modules:
 - 1. Provide minimum five year manufacturer warranty covering repair or replacement due to defective materials or workmanship.
 - 2. Provide manufacturer warranty guaranteeing minimum 90 percent of rated power output for 10 years and minimum 80 percent of rated power output for 20 years.
- D. Photovoltaic Module Mounting System: Provide minimum 10 year manufacturer warranty covering repair or replacement due to defective materials or workmanship.
- E. Photovoltaic Combiner Boxes: Provide minimum five year manufacturer warranty covering repair or replacement due to defective materials or workmanship.
- F. Photovoltaic Inverters: Provide minimum five year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

- G. Charge Controllers: Provide minimum five year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Photovoltaic Modules - Basis of Design: As indicated under product article below.
- B. Photovoltaic Modules, Crystalline Silicon:
 - 1. SolarEdge: www.solaredge.com
 - 2. Tier 1 Manufacturer per the latest list by Bloomberg
- C. Photovoltaic Module Mounting System:
 - 1. Cooper B-Line, a division of Cooper Industries: www.cooperindustries.com.
 - 2. Direct Power and Water Corporation: www.dpwsolar.com.
 - 3. TRA Snow and Sun: www.trasnowandsun.com/sle.
 - 4. Unirac, Inc: www.unirac.com.
- D. Photovoltaic Inverters - Basis of Design: Solar Edge
- E. Charge Controllers:
 - 1. Outback Power Technologies, Inc: www.outbackpower.com.
 - 2. Schneider Electric: www.schneider-electric.us/#sle.

2.2 PHOTOVOLTAIC SYSTEM REQUIREMENTS

- A. Provide complete photovoltaic system consisting of photovoltaic modules and associated balance of system components necessary for connection to facility electrical system.
- B. System Description:
 - 1. Photovoltaic array is roof-mounted in location indicated on the drawings.
 - 2. Photovoltaic DC system is negative grounded.
 - 3. System includes interconnection with utility grid (grid-tied system).
 - a. Utility metering configuration: Net metering.
 - 4. System includes DC system surge protection.
 - 5. System includes monitoring system.
 - 6. Owner intends to secure funds from available federal, state, and utility company rebate and incentive programs.
- C. Capacity:
 - 1. Total Nominal Rated Power Output of Array: Equal to or greater than the rated output of the basis of design array.
 - 2. Nominal Rated Power Output of Individual Modules: Equal to or greater than the rated output of the basis of design module.
- D. Size:
 - 1. Individual Modules: Same exact size as basis of design module.

- E. Appearance:
 - 1. Only systems with similar appearance to basis of design system will be considered.
 - 2. Arrange array such that modules are aligned with uniform spacing.
 - 3. Make no alterations affecting appearance of building exterior or interior without approval of Architect/Engineer.
 - 4. Final determination of acceptable appearance is by Architect/Engineer.
- F. Fire Resistance Rating: Provide photovoltaic module and mounting system combination that together with the roof covering form a system listed in accordance with UL 1703 to provide a fire rating equal to or better than the required fire rating of the roof.
- G. Provide photovoltaic system and associated components suitable for wind loads, snow loads, seismic loads, and other structural design considerations of the installed location.
 - 1. Comply with ASCE 7.
 - 2. Include structural calculations demonstrating compliance with submittals.
- H. Provide photovoltaic system and associated components suitable for continuous operation under the service conditions at the installed location.
- I. Provide products listed, classified, and labeled as suitable for the purpose intended.
- J. Provide photovoltaic system and associated components that qualify for available federal, state, and utility company rebate and incentive programs.
- K. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system.
- L. DC Arc Fault Circuit Protection: Provide DC photovoltaic arc-fault protection devices listed as complying with UL 1699B as required for compliance with NFPA 70.
- M. Rapid Shutdown of Photovoltaic Systems on Buildings: Provide listed equipment arranged to provide rapid shutdown in accordance with NFPA 70.
- N. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- O. Arrange array to minimize shading during peak production periods.
- P. Roof-Mounted Arrays:
 - 1. Arrange array such that normal roof drainage is not affected.
 - 2. Arrange array to maintain required safety clearances from edges of roof as required by authority having jurisdiction.
 - 3. Arrange array to maintain access and clearance requirements for other roof-mounted equipment.
 - 4. Arrange array to avoid spanning of expansion joints.

2.3 PHOTOVOLTAIC MODULES

- A. Acceptable Module Types: Either crystalline silicon or thin film modules complying with specified requirements will be considered for this project.

B. General Requirements:

1. Photovoltaic Modules: Factory assembled; consisting of photovoltaic cells, frame, junction box, cables for series connection, and bypass diodes for shade tolerance; rated for 600 V DC; complying with IEC 61215-1 and IEC 61215-2 and listed as complying with UL 1703.
2. Crystalline Silicon Photovoltaic Modules: Comply with IEC 61215-1-1.
3. Thin Film Photovoltaic Modules: Comply with IEC 61215-1-2, IEC 61215-1-3, or IEC 61215-1-4 as applicable.
4. Frame: Anodized aluminum.
5. Factory-Installed Junction Box: Weatherproof, with factory-installed terminals and bypass diodes.
6. Factory-Installed Cables: Type USE-2 or listed photovoltaic (PV) wire with polarized locking connectors.
7. Unless otherwise indicated, specified module performance characteristics are rated under Standard Test Conditions (STC).

2.4 BALANCE OF SYSTEM COMPONENTS

A. Photovoltaic Module Mounting System:

1. Provide complete mounting system compatible with modules to be installed and suitable to properly install them in the location indicated, including all necessary hardware and accessories.
2. Support Structure and Associated Hardware Materials: Use aluminum, galvanized steel, or stainless steel.
3. Roof-Mounted Arrays:
 - a. Acceptable System Types: Only non-penetrating systems are acceptable. Penetrating systems will not be considered for this project.
 - b. Provide system compatible with the roof at the installed location.
 - c. Module Tilt Angle: As required to provide maximum energy production for installed location.
 - d. Provide minimum clearance of 3 inches (76 mm) between roof and module for air circulation and drainage.

B. Photovoltaic Inverters:

1. Provide inverter(s) as indicated or as required for connection of the photovoltaic array DC system to the AC system indicated.
2. Inverters: Suitable for the requirements of the connected array; output configuration compatible with connected system; listed as complying with UL 1741; furnished with the following features:
 - a. Maximum power point tracking (MPPT).
 - b. LCD display.
 - c. Integral AC disconnect.
 - d. Integral DC disconnect.

- e. Integral DC ground fault detection and interruption (GFDI).
- f. Communications Interface: Wireless.
- 3. Grid-Tied Inverters: Comply with IEEE 1547, including over/under grid voltage and frequency protection, and anti-islanding protection to automatically disconnect upon loss of utility power and to remain disconnected until utility power restoration has been maintained for five minutes.
- 4. Grounded Photovoltaic DC Systems: Furnish with integral isolation transformer. Transformerless inverters may be used if a separate isolation transformer is provided.
- 5. Total Harmonic Distortion: Less than five percent.
- 6. Enclosure Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
- C. Isolation Transformers: Comply with Section 26 2200.
- D. Enclosed Switches, in Addition to Requirements of Section 26 2816.16:
 - 1. Switches for DC System: Rated for 600 V DC.
 - 2. Switches Connected to Supply Side of Service Disconnecting Means: Listed and labeled as suitable for use as service equipment according to UL 869A.
- E. Charge Controllers: Suitable for the requirements of the connected battery storage system; no readily accessible user adjusting means; listed as complying with UL 1741.
- F. Surge Protective Devices, in Addition to Requirements of Section 26 4300:
 - 1. Surge Protective Devices for DC System:
 - a. Rated for 600 V DC.
 - b. Listed and labeled as complying with UL 1449, Type 1.
 - c. Surge Current Rating: Not less than 50 kA per mode.
 - d. UL 1449 Nominal Discharge Current (I-n): 20 kA.
- G. Molded-Case Circuit Breakers and Switches for DC System: Rated for 600 V DC; listed as complying with UL 489B.
- H. Monitoring System:
 - 1. Provide a system to monitor photovoltaic system performance including all sensors, dataloggers, connections, software, equipment and accessories necessary for a complete operating system.
 - 2. System communications interfaces to be wired or wireless, with compatible interconnected components.
 - a. Provide suitable raceway, minimum 3/4 inch (21 mm) trade size, for all required wired connections.
 - 3. System to monitor and record, in 15 minute intervals:
 - a. Inverter status.
 - b. Instantaneous power (kW).
 - c. Cumulative energy production (kWh).
 - d. Ambient temperature.

- e. Wind speed and direction.
- 4. Energy Production Meter: Revenue grade, with accuracy of plus or minus two percent.
- 5. System real-time and historical data to be accessible from the following locations:
 - a. Personal computer(s), via internet connection.
 - b. Remote public display(s), quantity and location as indicated on the drawings.
- 6. System to provide alarm notification via e-mail or instant message.
- 7. System to be compatible with third party monitoring service to be selected by Owner.

2.5 SOURCE QUALITY CONTROL

- A. Factory test the following products to verify operation and performance characteristics. Include test reports with submittals.
 - 1. Photovoltaic modules.
 - 2. Photovoltaic inverters.
 - 3. Charge controllers.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that ratings and configurations of system components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive system components.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Use open circuiting, short circuiting, or opaque covering to disable modules, array or portions of array prior to installation and service.
- B. Roof-Mounted Arrays: Protect roof and adjacent roof-mounted items from damage.

3.3 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install photovoltaic system in accordance with NECA 412.
- D. Provide required supports in accordance with Section 26 0529.
- E. Mount equipment such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches (2000 mm) above the floor, ground, or working platform.
- F. Circuiting Requirements. in Addition to Requirements of Section 26 0519:
 - 1. Wiring Methods:
 - a. Unless otherwise indicated, use exposed module factory-installed cables (not routed inside building) for module interconnections.

- b. Secure exposed cables in accordance with NFPA 70. Where possible, conceal behind array.
 - c. Install cables in suitable raceway where readily accessible or where required by authority having jurisdiction.
 - d. Use suitable twist-on insulated spring connectors, mechanical connectors, or compression connectors for photovoltaic circuit splices and taps.
 - 2. Photovoltaic DC System Conductor Color Code:
 - a. Negative Grounded System:
 - 1) Positive: Red.
 - 2) Negative/Grounded: White.
 - 3. Maintain separation of photovoltaic and non-photovoltaic circuits in accordance with NFPA 70.
- G. Grounding and Bonding Requirements, in Addition to Requirements of Section 26 0526:
- 1. Ensure that there is only one AC System bonding connection between grounding system and grounded/neutral conductor, including external connections and connections internal to equipment.
 - 2. Grounded DC Systems: Ensure that there is only one point of system grounding connection to the grounded conductor, including external connections and connections internal to equipment.
 - 3. Provide auxiliary electrodes for photovoltaic array grounding in accordance with NFPA 70.
- H. Identification Requirements, in Addition to Those Specified in Section 26 0553:
- 1. Color for Photovoltaic System Identification Nameplates and Labels: White text on red background, unless otherwise required by NFPA 70 or authorities having jurisdiction.
 - 2. Use identification nameplate or means of identification acceptable to authority having jurisdiction to identify the presence of multiple power sources and the location of main service disconnecting means and each photovoltaic system disconnecting means. Locate at main service disconnecting means and at each photovoltaic system disconnecting means. Verify format and descriptions with authorities having jurisdiction.
 - 3. Use identification nameplate to identify each photovoltaic system disconnecting means with text "PV SYSTEM DISCONNECT".
 - 4. Use identification nameplate or identification label to identify systems equipped with rapid shutdown and associated rapid shutdown switch(es). Format, descriptions, and locations to comply with NFPA 70 and requirements of authorities having jurisdiction.
 - 5. Use identification nameplate or identification label to identify the information required by NFPA 70 for marking of direct-current photovoltaic power sources. Locate at each DC disconnect means requiring marking.
 - 6. Use identification nameplate or identification label to identify the interactive system point of interconnection at the disconnecting means as a power source and with the rated AC output current and the nominal operating AC voltage.
 - 7. Use warning labels to identify electrical hazards for photovoltaic system disconnecting means. Include the word message "Warning - Electric Shock Hazard; Terminals on the line and load sides may be energized in the open position" or approved equivalent.

8. Use wire and cable markers to identify photovoltaic system source, output, and inverter circuit conductors at all points of termination, connection, and splices.
9. Use voltage markers, identification labels, stenciled text, or suitable permanent marking approved by authority having jurisdiction to identify exposed raceways, cable trays, pull boxes, junction boxes, and conduit bodies with the text "Warning: Photovoltaic Power Source" at maximum intervals of 10 feet (3 m) in accordance with NFPA 70.

3.4 FIELD QUALITY CONTROL

- A. See article "SYSTEM STARTUP" below for additional requirements related to testing and inspection.
- B. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.
- C. Inspection and testing to include, at a minimum:
 1. Inspect each system component for damage and defects.
 2. Verify that equipment enclosures, boxes, and associated connections installed outdoors are weatherproof.
 3. Verify proper wiring connections have been made and check for conductor continuity. Verify proper polarity.
 4. Verify tightness of mechanical and electrical connections are according to manufacturer's recommended torque settings.
 5. Perform insulation resistance tests.
 - a. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
 6. Measure and record voltages at the inverter AC and DC inputs.
 7. Measure and record AC output power.
 8. Perform inverter functional test.
 - a. Grid-Tied Inverters: Include simulation of loss of utility power and subsequent power restoration.
 9. Verify proper operation of monitoring system.
- D. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.
- E. Repair roof or adjacent roof-mounted items damaged as a result of work of this section.

3.5 SYSTEM STARTUP

- A. Provide services of a manufacturer's authorized representative to assist in performing system startup. Include manufacturer's detailed startup procedures with submittals.
- B. Obtain Owner's approval prior to performing system startup.
- C. Grid-Tied Systems: Obtain Utility Company's approval prior to performing system startup.
- D. Prepare and start system in accordance with manufacturer's instructions.

3.6 CLEANING

- A. Clean modules using only methods recommended by manufacturer to avoid scratches and other damage. Clean exposed surfaces on other components to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's personnel on operation, adjustment, and maintenance of photovoltaic system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of four hours of training.

3.8 PROTECTION

- A. Protect installed products from subsequent construction operations.

3.9 MAINTENANCE

- A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide to Owner, a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of photovoltaic system for two years from date of Substantial Completion, to include the work described below; Include a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.
- C. Conduct site visit at least once every six months to perform inspection, testing, and preventive maintenance. Conduct tests similar to those made during original field quality control testing. Submit report to Owner comparing test results with those of original tests along with evaluations and recommendations.
- D. Provide trouble call-back service upon notification by Owner:
 - 1. Include allowance for call-back service during normal working hours at no extra cost to Owner.
 - 2. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

END OF SECTION

**SECTION 26 5100
INTERIOR LIGHTING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior luminaires.
- B. Exit signs.
- C. Ballasts and drivers.
- D. Lamps.
- E. Luminaire accessories.

1.2 RELATED REQUIREMENTS

- A. Section 26 0533.16 - Boxes for Electrical Systems.
- B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- C. Section 26 0923 - Lighting Control Devices: Automatic controls for lighting including occupancy sensors, outdoor motion sensors, time switches, outdoor photo controls, and daylighting controls.
- D. Section 26 2726 - Wiring Devices: Manual wall switches and wall dimmers.

1.3 REFERENCE STANDARDS

- A. 47 CFR 15 - Radio Frequency Devices; current edition.
- B. ANSI C82.11 - American National Standard for Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts - Supplements; 2017.
- C. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
- D. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; 2008.
- E. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; 2015, with Errata (2017).
- F. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- G. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; 2025.
- H. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.
- I. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2016.
- J. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2012.
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

- M. UL 1598C - Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits; Current Edition, Including All Revisions.
- N. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- O. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
 - 2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
 - 3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
 - 4. Notify Architect/Engineer of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
 - 2. Provide photometric calculations where luminaires are proposed for substitution upon request.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
 - 1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
 - b. Include IES LM-79 test report upon request.
 - 2. Ballasts: Include wiring diagrams and list of compatible lamp configurations.
 - 3. Lamps: Include rated life, color temperature, color rendering index (CRI), and initial and mean lumen output.
- D. Certificates for Dimming Ballasts: Manufacturer's documentation of compatibility with dimming controls to be installed.
- E. Field quality control reports.
- F. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

- G. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.8 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for all LED luminaires, including drivers.
- C. Provide three year full warranty for fluorescent emergency power supply units.

PART 2 PRODUCTS

2.1 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.2 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Recessed Luminaires:
 - 1. Ceiling Compatibility: Comply with NEMA LE 4.
 - 2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
 - 3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.
- H. LED Luminaires:
 - 1. Components: UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.3 EXIT SIGNS

- A. Description: Internally illuminated exit signs with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes and listed and labeled as complying with UL 924.
 - 1. Number of Faces: Single or double as indicated or as required for the installed location.
 - 2. Directional Arrows: As indicated or as required for the installed location.
- B. Self-Powered Exit Signs:
 - 1. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination and automatically recharges battery upon restoration of normal power source.
 - 2. Battery: Sealed maintenance-free nickel cadmium unless otherwise indicated.
 - 3. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
 - 4. Provide low-voltage disconnect to prevent battery damage from deep discharge.
 - 5. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101; provide indicator light(s) to report test and diagnostic status.

2.4 BALLASTS AND DRIVERS

- A. Ballasts/Drivers - General Requirements:
 - 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
 - 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
 - 3. Electronic Ballasts/Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.
 - 4. Operate for at least 50,000 hours at maximum case temperature and 90 percent non-condensing relative humidity.

5. Provide thermal fold-back protection by automatically reducing power output (dimming) to protect LED driver and LED light engine/fixture from damage due to over-temperature conditions that approach or exceed the LED driver's maximum operating temperature at calibration point
 6. Provide integral recording of operating hours and maximum operating temperature to aid in troubleshooting and warranty claims.
 7. Designed and tested to withstand electrostatic discharges incurred during manufacturing, installation, or field troubleshooting without impairment of performance when tested according to IEC 61000-4-2.
 8. Manufactured in a facility that employs ESD reduction practices in compliance with ANSI/ESD S20.20.
 9. UL 8750 recognized or listed as applicable.
 10. NRTL Type TL rated where possible to allow for easier fixture evaluation and listing of different driver series.
 11. UL 1598C listed for field replacement as applicable.
 12. Designed and tested to withstand Category A surges of 4,000 V according to IEEE C62.41.2 without impairment of performance.
 13. Class A sound rating; inaudible in a 27 dBA ambient.
 14. Demonstrate no visible change in light output with a variation of plus or minus 10 percent change in line-voltage input.
 15. LED drivers of the same family/series to track evenly across multiple fixtures at all light levels.
 16. Employ integral fault protection up to 277 V to prevent LED driver damage or failure in the event of incorrect application of line-voltage to communication link inputs.
- B. LED Drivers
1. Operate from input voltage of 120 V through 277 V at 50/60 Hz.
 2. Complies with FCC requirements of 47 CFR 15, for commercial applications at 120-277 V and residential applications at 120 V.
 3. Total Harmonic Distortion (THD): Less than 20 percent at maximum power; complies with ANSI C82.11.
 4. Class 2 output designed to withstand hot swap of LED loads; meets UL 1310 and CSA C22.2 No. 223.
 5. Driver outputs to be short circuit protected, open circuit protected, and overload protected.

2.5 LAMPS

A. Lamps - General Requirements:

1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.

4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect/Engineer to be inconsistent in perceived color temperature.

2.6 ACCESSORIES

- A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.
- B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of luminaires provided under this section.
- B. Install products in accordance with manufacturer's instructions.
- C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).
- D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- E. Suspended Ceiling Mounted Luminaires:
 1. Do not use ceiling tiles to bear weight of luminaires.
 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
 3. Secure surface-mounted and pendant-mounted luminaires to building structure.
 4. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.

5. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gage, connected from opposing corners of each recessed luminaire to building structure.
 6. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- F. Recessed Luminaires:
1. Install trims tight to mounting surface with no visible light leakage.
 2. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.
- G. Suspended Luminaires:
1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
 2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
 3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet (1.2 m) between supports.
 4. Unless otherwise indicated, support pendants from swivel hangers.
- H. Install accessories furnished with each luminaire.
- I. Bond products and metal accessories to branch circuit equipment grounding conductor.
- J. Fluorescent Luminaires Controlled by Dual-Level Switching: Connect such that each switch controls the same corresponding lamps in each luminaire.
- K. Exit Signs:
1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect each product for damage and defects.
- C. Operate each luminaire after installation and connection to verify proper operation.
- D. Test fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.
- E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect/Engineer.

3.5 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect/Engineer. Secure locking fittings in place.
- B. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect/Engineer or authority having jurisdiction.

3.6 CLEANING

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Just prior to Substantial Completion, replace all lamps that have failed.

3.8 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

**SECTION 26 5600
EXTERIOR LIGHTING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Exterior luminaires.
- B. Ballasts.
- C. Lamps.

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0533.16 - Boxes for Electrical Systems.

1.3 REFERENCE STANDARDS

- A. AASHTO LTS - Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals; 2013, with Editorial Revision (2025).
- B. ANSI C82.4 - American National Standard for Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type); 2002.
- C. IEEE C2 - National Electrical Safety Code; 2017.
- D. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; 2008.
- E. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; 2015, with Errata (2017).
- F. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- G. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems; 2006.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 1029 - High-Intensity-Discharge Lamp Ballasts; Current Edition, Including All Revisions.
- J. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- K. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.
 - 2. Notify Architect/Engineer of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
 - 1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
 - 2. Lamps: Include rated life and initial and mean lumen output.
 - 3. Poles: Include information on maximum supported effective projected area (EPA) and weight for the design wind speed.
- C. Certificates for Poles and Accessories: Manufacturer's documentation that products are suitable for the luminaires to be installed and comply with designated structural design criteria.
- D. Field Quality Control Reports.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- F. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- G. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.8 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for all LED luminaires, including drivers.

PART 2 PRODUCTS

2.1 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.2 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. LED Luminaires:
 - 1. Components: UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.3 BALLASTS

- A. Ballasts/Drivers - General Requirements:
 - 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
 - 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
- B. LED Drivers: RoHS compliant, 120-277V input voltage, 0-10V dimming,
 - 1. LED Driver is certified by UL Class 2 for use in dry or damp location.
 - 2. LED Driver has a Class A sound rating.
 - 3. LED Driver has a minimum operating ambient temperature of -40C.
 - 4. LED Driver has a life expectancy of 50,000 hours at Tcase of $\leq 70C$.
 - 5. LED Driver tolerates sustained open circuit and short circuit output conditions without damage.
 - 6. LED Driver complies with FCC rules and regulations, as per Title 47 CFR Part 15 Non-Consumer (Class A).

2.4 LAMPS

- A. Lamps - General Requirements:
 - 1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.

2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect/Engineer to be inconsistent in perceived color temperature.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install luminaires in accordance with NECA/IESNA 501.
- E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- F. Install accessories furnished with each luminaire.
- G. Bond products and metal accessories to branch circuit equipment grounding conductor.
- H. Install lamps in each luminaire.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect each product for damage and defects.
- C. Operate each luminaire after installation and connection to verify proper operation.

- D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect/Engineer.

3.5 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect/Engineer. Secure locking fittings in place.
- B. Luminaires with Field-Rotatable Optics: Position optics according to manufacturer's instructions to achieve lighting distribution as indicated or as directed by Architect/Engineer.

3.6 CLEANING

- A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of luminaires to Architect/Engineer, and correct deficiencies or make adjustments as directed.
- D. Just prior to Substantial Completion, replace all lamps that have failed.

3.8 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

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**SECTION 27 1300
COMMUNICATIONS BACKBONE CABLING**

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pathways.
 - 2. 9/125-micrometer, optical fiber cabling.
 - 3. Cable connecting hardware, patch panels, and cross-connects.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. EMI: Electromagnetic interference.
- D. IDC: Insulation displacement connector.
- E. LAN: Local area network.
- F. UTP: Unshielded twisted pair.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.5 ACTION SUBMITTALS

- A. Shop Drawings:
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 - 3. Wiring diagrams to show typical wiring schematics including the following:
 - a. Cross-connects.
 - b. Patch panels.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
 - 2. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: An NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- 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. Products: Listed, classified, and labeled as suitable for the purpose intended.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- F. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical fiber flashlight.
 - 2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.

1.8 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 PRODUCTS

2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Conduit and Boxes: Comply with requirements in Section 260533 "Raceway and Boxes for Electrical Systems."
 - 1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

- A. Backboards: Plywood, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Section 061000 "Rough Carpentry" for plywood backing panels.

2.3 OPTICAL FIBER CABLE - FURNISHED BY OWNER, INSTALLED BY CONTRACTOR

- A. Description: Singlemode, 9/125-micrometer, (6/24/48)-fiber, tight buffer, optical fiber cable.
 - 1. Comply with ICEA S-83-596 for mechanical properties.
 - 2. Comply with TIA/EIA-568-B.3 for performance specifications. Provide OM2.
 - 3. Comply with TIA/EIA-492AAAA-B for detailed specifications.
 - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 - 5. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
 - 6. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
- B. Jacket:
 - 1. Single-Mode Fiber (OS1/OS2): Yellow.
 - 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
 - 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.4 GROUNDING

- A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

2.5 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.6 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test cables on reels according to TIA/EIA-568-B.1.
- C. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

PART 3 EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Section 271100 "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Section 260533 "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- F. Pathway Installation in Communications Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard when entering room from overhead.
 - 4. Extend conduits 3 inches (76 mm) above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- G. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.4 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

4. Cables may not be spliced, unless approved by County. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
 7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 9. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
 10. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. Optical Fiber Cable Installation:
1. Comply with TIA/EIA-568-B.3.
 2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- D. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- E. Group connecting hardware for cables into separate logical fields.
- F. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).

- b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
- c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
- 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
- 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
- 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.5 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-B. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 1. Administration Class: 3.
 - 2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration.
- D. Comply with requirements in Section 271500 "Communications Horizontal Cabling" for cable and asset management software.

Communications Backbone

Cabling

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- E. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- G. Cable and Wire Identification:
 - 1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:
 - 1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 2. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:
 - 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
 - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
- C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

- D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 271300

**SECTION 27 1500
COMMUNICATIONS HORIZONTAL CABLING**

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Cable connecting hardware, patch panels, and cross-connects.
 - 2. Telecommunications outlet/connectors.
 - 3. Cabling system identification products.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- D. EMI: Electromagnetic interference.
- E. IDC: Insulation displacement connector.
- F. LAN: Local area network.
- G. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.
- H. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- I. RCDD: Registered Communications Distribution Designer.
- J. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For coaxial cable, include the following installation data for each type used:
 - a. Nominal OD.

- b. Minimum bending radius.
 - c. Maximum pulling tension.
- B. Shop Drawings:
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 - 3. Cabling administration drawings and printouts.
 - 4. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.
 - 5. Cross-connects and patch panels. Detail mounting assemblies and show elevations and physical relationship between the installed components.
- C. Samples: For workstation outlets, jacks, jack assemblies, in specified finish, one for each size and outlet configuration.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For splices and connectors to include in maintenance manuals.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
 - 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

- B. Testing Agency Qualifications: An NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- C. Products: Listed, classified, and labeled as suitable for the purpose intended.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test optical fiber cables to determine the continuity of the strand end to end. Use optical fiber flashlight.
 - 2. Test optical fiber cables while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; including the loss value of each. Retain test data and include the record in maintenance data.
 - 3. Test each pair of UTP cable for open and short circuits.

PART 2 PRODUCTS

2.1 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.
 - 1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
 - 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
 - 3. Bridged taps and splices shall not be installed in the horizontal cabling.
 - 4. Splitters shall not be installed as part of the optical fiber cabling.
- B. A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the telecommunications outlet/connectors to the station equipment.
- C. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment or in the horizontal cross-connect.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Grounding: Comply with J-STD-607-A.

2.3 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Belden CDT Inc.; Electronics Division.
 - 2. Berk-Tek; a Nexans company.
 - 3. CommScope, Inc.
 - 4. Draka USA.
 - 5. Hubbell Premise Wiring
 - 6. Mohawk; a division of Belden CDT.
 - 7. OCC
 - 8. Superior Essex Inc.
 - 9. SYSTIMAX Solutions; a CommScope Inc. brand.
- B. Description: 100-ohm, four-pair UTP, covered with a blue thermoplastic jacket.
 - 1. Comply with ICEA S-90-661 for mechanical properties.
 - 2. Comply with TIA/EIA-568-B.1 for performance specifications.
 - 3. Comply with TIA/EIA-568-B.2, Category 6.
 - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.

2.4 UTP CABLE HARDWARE

- A. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- B. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
- C. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
 - 1. Number of Terminals per Field: One] for each conductor in assigned cables.
- D. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - 1. Number of Jacks per Field: One for each four-pair UTP cable indicated.
- E. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

- F. Patch Cords: Factory-made, four-pair cables in 36-inch (900 mm) lengths; terminated with eight-position modular plug at each end.
 - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
 - 2. Patch cords shall have color-coded boots for circuit identification.

2.5 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA-526-14-A and TIA/EIA-568-B.3.
- E. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- F. Cable will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

PART 3 EXECUTION

3.1 WIRING METHODS

- A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters. Conceal pathways and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
- B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures:
 - 1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
 - 2. Install lacing bars and distribution spools.
 - 3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.2 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.

4. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
 - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
 - b. Locate consolidation points for UTP at least 49 feet (15 m) from communications equipment room.
5. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
6. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
9. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
10. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
11. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
12. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
 1. Comply with TIA/EIA-568-B.2.
 2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
- D. Optical Fiber Cable Installation:
 1. Comply with TIA/EIA-568-B.3.
 2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- E. Open-Cable Installation:
 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- F. Installation of Cable Routed Exposed under Raised Floors:
 1. Install plenum-rated cable only.
 2. Install cabling after the flooring system has been installed in raised floor areas.

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3. Coil cable 6 feet (1800 mm) long not less than 12 inches (300 mm) in diameter below each feed point.
- G. Outdoor Coaxial Cable Installation:
 1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
 2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).
- H. Group connecting hardware for cables into separate logical fields.
- I. Separation from EMI Sources:
 1. Comply with BICSI TDMM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.3 FIRESTOPPING

- A. Comply with TIA-569-B, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.4 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.5 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 1. Administration Class: 1.
 - 2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.
- C. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration.
- E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.
- G. Cable and Wire Identification:
 - 1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).

4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
 6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.
- H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections:
 1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with TIA/EIA-568-B.1.
 2. Visually confirm Category 5e, marking of outlets, cover plates, outlet/connectors, and patch panels.
 3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 5. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

- b. Link End-to-End Attenuation Tests:
 - 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA-526-14-A, Method B, One Reference Jumper.
 - 2) Attenuation test results for backbone links shall be less than 2.0 db. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
- 6. UTP Performance Tests:
 - a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
 - 1) Wire map.
 - 2) Length (physical vs. electrical, and length requirements).
 - 3) Insertion loss.
 - 4) Near-end crosstalk (NEXT) loss.
 - 5) Power sum near-end crosstalk (PSNEXT) loss.
 - 6) Equal-level far-end crosstalk (ELFEXT).
 - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
 - 8) Return loss.
 - 9) Propagation delay.
 - 10) Delay skew.
- 7. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.3.
- 8. Coaxial Cable Tests: Conduct tests according to Section 274133 "Master Antenna Television System."
- 9. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.
 - a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
 - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
- D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets.

END OF SECTION 271500

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**SECTION 32 9100
LANDSCAPE PLANTING**

PART 1 GENERAL

1.1 WORK INCLUDED

- A. The Contractor shall furnish all labor, materials, tools, equipment, supervision, and services necessary to install plant material, preparation of soil, fine grading, planting, mulching, landscape stone, guying, pruning, watering, edging, and the proper disposal of any excess earth or debris, maintenance all in accordance with the accompanying Drawings and these Specifications.

1.2 RELATED SECTIONS

- A. 32 9200 Seeding
B. 32 9300 Sodding

1.3 QUALITY ASSURANCE

A. Regulatory Requirements

1. Comply with applicable requirements of Federal, State, and Local laws, regulations and codes having jurisdiction at the project site. The Contractor shall take out all required permits, arrange for all necessary inspections and shall pay any fees and expenses in conjunction with the same as a part of the work under this section.
2. Contractor shall be responsible for certificates of inspection of plant material that may be required by Federal and Local authorities to accompany shipments of plants.
3. The entire installation shall fully comply with all local and state laws and ordinances and with all the established codes applicable thereto.
4. Local zone hardy plant material shall be utilized.

B. Reference Standards

1. "Standardized Plant Names" by the American Joint Committee of Horticultural Nomenclature.
 - a. "American Standard of Nursery Stock" by the American Association of Nurseryman current edition. Standards: All plant materials, methods, etc., are to conform to the Standards of the American Association for Nursery Stock. In the event there is a discrepancy between these standards and this Specification, the most restrictive requirement shall govern.
 - b. Nomenclature: The names of plants required under this Contract conform to those given in the "Standardized Plant Names", current edition, prepared by the American Joint Committee on Horticultural Nomenclature. Names of varieties not included therein conform generally with names accepted in the nursery code.
 - c. American National Standards Institute (ANSI); Publication Z60.1-current edition.
 - d. "Specifications for Turfgrass Sod" by the Sod Producers Association (A.S.P.A.).

C. Inspection of Plant Material

1. The nursery supplier shall tag and photograph all plant material to be delivered to the site. Photographs shall be sent to the Owner and/or Owner's Representative and Contractor for review and coordination. A nursery inspection by the Owner and/or Owner's Representative or Contractor may be required and shall be determined on a per job basis.
2. At the time the plant material is delivered to the job site, the Contractor shall be responsible to inspect plant material and reject any material that does not meet standards detailed in ANSI Publication Z60.1-current edition standards and Section 2.4 of this specification. Plant material shall be unwrapped in order to thoroughly inspect trunk, bark, branches, rootball, leaders and form. If material is rejected it shall be sent back to the nursery at the time of delivery at no additional charge to the owner or contractor.
3. The Owner and/or Owner's Representative shall be notified of plant inspection times at least 3 days prior by the Contractor once plant delivery has begun.

D. Coordination

1. Work in conjunction with other trades as directed, taking all reasonable precautions to avoid disturbance or interference with any other operation or installation on the site. Contractors shall be responsible for the cost of replacing any material damaged as a result of his/her negligence.

E. Points of Inspection: The Contractor shall notify the Owner and/or Owner's Representative at least five (5) days prior to start of work, inspections, or delivery to the Project Site to allow for inspection scheduling for each of the following work activities listed below. The notice must be sent via confirmable email or facsimile transmission to the Owner and/or Owner's Representative.

1. Pre-Installation Meeting: The Contractor shall meet with the Owner and/or Owner's Representative to review schedule, submittals, and project expectations. This meeting shall occur at least 10 days prior to the start of any work or deliveries to the job site.
2. 1st Inspection Meeting: The Contractor shall notify the Owner and/or Owner's Representative 5 days in advance for review on plant stock delivery, balled and burlapped tree planting procedures, plant bed preparation, and other review. This meeting shall occur before planting begins to ensure beds are correct and the proper planting procedures are followed.
3. Plant stock delivery: Contractor shall notify the Owner and/or Owner's Representative at least two (2) days in advance of delivery of plant material. The Owner and/or Owner's Representative must approve all plant material before installation.
4. Progress Inspections: The Owner's Representative will observe the site to monitor correct planting procedures, coordinate on unexpected site conditions, and inspection of additional plant stock on site.
5. Punch List Inspection(s): A punch list by the Landscape Architect shall be created and sent to the Contractor to coordinate any clean up, plant replacement, and repair. Refer to PART 3 -Section 3.5 for requirements.
6. One Year Warranty Inspection: Refer to PART 3 -Section 3.7

1.4 SUBMITTALS

- A. Contractor shall submit the following to the Owner and/or Owner's Representative at least thirty (30) days prior to start of the work
 - 1. The source and supplier of all plant material, planting schedule, fertilizer, hardwood mulch, rock mulch, pavers, stone boulders (photos), soil amendments and other materials along with the type of equipment to be used on this project.
 - 2. Physical samples of the following: Rock mulch,
- B. Grower's Certificates: Proof of certification of Nursery Stock Grower and Dealer Inspection as well as any other certificates required by governmental authorities.
- C. Fertilizer Manufacturer's Certificate of Compliance: Written documentation verifying compliance with chemical analysis of fertilizer furnished. Submit to Owner and/or Owner's Representative 5 days prior to delivery.
- D. Substitutions: Substitutions of plant material will not be permitted unless authorized in writing by the Owner and/or Owner's Representative. If proof is submitted that any plant specified is not obtainable, a proposal will be considered for use of the nearest equivalent size or variety with corresponding adjustment of Contract Price. Such proof shall be substantiated and submitted in writing to the Owner and Owner and/or Owner's Representative at least thirty (30) days prior to start of the work under this Section. These provisions shall not relieve the Contractor of the responsibility of obtaining specified materials in advance if special growing conditions or other arrangements must be made in order to supply specified materials.

1.5 STORAGE, HANDLING, AND DELIVERY

- A. Storage of Materials
 - 1. All materials delivered to the job shall be stored so as to keep them in new condition and free from deterioration. Fertilizer, etc., shall be stored in temporary sheds off-site at Contractor's expense.
 - 2. All nursery stock must be kept secure, cool, and moist while being stored. If storing B&B plants on site, store in either a refrigerated truck or heeled into soil or mulch.
- B. Packaged Materials
 - 1. Deliver packaged materials in unopened containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery and while stored at site.
- C. Plant Material
 - 1. Plants shall not be delivered to the site until the corresponding beds are fully prepared and approved. Vegetated material shall be inspected upon delivery at job site by the Contractor. All materials must arrive with identification labels calling out the size and species name. All plant material is subject to rejection by the Contractor, Owner and/or Owner's Representative either at time of delivery or at the 1 year warranty inspection, provided it does not comply with the requirements stated herein. Any rejected stock shall be immediately removed from the premises and replaced with approved stock.
 - 2. All plant tags shall stay on plants through planting and shall NOT be removed until Owner and/or Owner's Representative has performed the initial inspection. The plant tags shall be removed, collected, and provided to the owner once Initial Inspection is completed.

1.6 JOB CONDITIONS

A. Examination of Site:

1. The bidder must acknowledge that he has examined the site, Drawings and Specifications and the submission of a quotation shall be considered evidence that examinations have been made.
 - a. Field Conditions: The Contractor shall verify drawing dimensions with actual field conditions and inspect related work and adjacent surfaces. The Contractor shall report to the Owner and/or Owner's Representative all conditions which prevent proper execution of this work. The Contractor agrees to be fully responsible for any and all damage which might be occasioned by the Contractor's failure to exactly locate and preserve any and all utilities, structures, and geogrid reinforcement.
- 1) Soil moisture must be at or below field capacity to avoid destroying the soil structure before any work begins.

1.7 SEQUENCING/SCHEDULING

A. Planting Time: Proceed with and complete planting as rapidly as portions of the site become available, working within seasonal limitations for each kind of landscape work required.

B. Allowable Planting Dates:

1. Evergreen Plants: September 1 to October 15 and prior to June 1, but not after candles exceed 1 inch.
2. Deciduous Plants (Balled and Burlapped and Container): August 15 to November 15 or the 1st frost of the season and in the spring prior to June 1
3. Perennials: August 15 to October 15 and prior to June 1.
4. Weather Restrictions: Planting may be conducted under unseasonable conditions, except in weather below 32 degrees or above 90 degrees. No variance from plant warranty or other requirements will be given for plants installed outside the specified period.

1.8 MATERIALS CLEAN-UP

A. The Contractor shall keep the premises free from rubbish and all debris associated with their work at all times and all unused materials and debris shall be removed from the site.

PART 2 MATERIALS

2.1 TOPSOIL

- A. Refer to Section 31 2001 Earthwork, Part 2.1 Topsoil.
- B. Topsoil shall be fertile, natural topsoil, typical of the locality. Stockpiled topsoil may be used if approved by the Owner and/or Owner's Representative. It shall be free of subsoil, slag, clay, stones, lumps, sticks, plants or their roots, toxic substances or other extraneous matter that may be harmful to plant growth or would interfere with future maintenance.

2.2 PLANTING BED SOIL MIXTURE

- A. Replace the top 12" of existing soil for planting tree holes and beds with a new planting media consisting of 75% horticultural value topsoil mixed with 25% organic compost. Submit data for approval.
- B. Very poor soils of clay, gumbo, gravel, hard-pan, or other soils injurious to plants shall not be used. Notify Owner/Owner's Representative if these conditions exist before proceeding.

2.3 INFILTRATION PROFILE

- A. Infiltration soil mixture shall be a thoroughly mixed composition of 10% planting soil, 80% clean construction sand and 10% organic leaf compost to a depth of 18". Mix thoroughly prior to installation.
- B. Provide Stone Aggregate Choker Layer to be 3/8" granular chip rock.
- C. Provide Stone Aggregate Base Layer to comply with Iowa DOT Section 4115, Gradation No.3, Class 2 Durability gravel or crushed stone (AASHTO M 43/ASTM 448, Size 57).

2.4 FERTILIZER

- A. All fertilizers shall be horticultural grade complete formula fertilizers and shall conform to the applicable State Fertilizer Laws. Fertilizer shall consist of uniform dry granulated nutrients produced by mining and manufacturing processes and commonly used in the agricultural or lawn care industries. It shall contain the three major plant nutrients of nitrogen, phosphorous, and potassium. Commercial fertilizer may be furnished as a homogenous or blended form. Submit product information for Owner and/or Owner's Representative approval.
- B. Slow release fertilizers: A minimum of 70 percent of the nitrogen component shall be a slow release water insoluble nitrogen.

2.5 PLANT MATERIALS

- A. Plant Schedule: A list of plant materials is scheduled on the Drawings. In the event of any discrepancy between this schedule and the Plan Drawing showing the plants, the Plan Drawing shall govern.
- B. Certification of inspection of plant materials required by Federal, State, or other governmental agencies to accompany all shipments to be furnished to the Owner and/or Owner's Representative. Plants shall have been grown under climatic conditions similar to those in the locality of the project.
- C. Planting stock shall be well-branched and well formed, sound, vigorous, healthy, free from disease, sun-scale, windburn, abrasion, and harmful insects or insect eggs; and shall have healthy, normal unbroken root systems. Deciduous trees and shrubs shall be symmetrically developed with branches of uniform growth, with straight trunks and central leaders, and free from objectionable disfigurements. One-sided branching plant material will be rejected.
- D. Evergreen trees and shrubs shall have well-developed symmetrical tops with typical spread of branches for each particular species or variety. Evergreen leaders shall be straight and central. Evergreen trees and shrubs shall not be sheared.
- E. Stock Sizes: All stock measurements - caliper, height, branching level, number of canes, ball sizes shall be in strict accordance with the latest edition of the American Standard for Nursery Stock, unless otherwise noted on the plans. Plants used on the project shall meet or exceed all minimum requirements indicated in the size, condition, and remarks sections of the planting legend on the plan sheets.

- F. Provide plants free of the following:
 - 1. Harmful insects, insect eggs, borers, and all forms of infestation
 - 2. Plant diseases and moldy or dried roots
 - 3. Damage to trunk, bark, branches, leaders, root systems, or cut-leaders
 - 4. Defects, disfiguring knots, sunscald injuries, and frost cracks
 - 5. Rodent or deer damage to bark and buds
- G. Plants with broken or cut back terminal leaders will be rejected. Plants with crooked or split leaders will be rejected.
- H. All stock shall be balled and burlapped or container grown stock. Bareroot stock of any kind is unacceptable.
- I. All plant material must be watered the same day it is planted in order to comply with these Specifications.
- J. Delivered trees with more than 4" or more of soil over the root flare shall be rejected. If after carefully removing the soil over the trunk flare unveils encircling or excessive roots and/or unhealthy conditions the tree will be rejected. The trunk of the tree shall not be more than 10% off center within the rootball. The Contractor, Owner and/or Owner's Representative may open soil balls to inspect for root condition, size, balance, and trunk location within the ball.
- K. Ornamental grasses and perennials shall be inspected by root mass and top growth. Containers shall be removed to ensure roots have grown to the width and the depth of the container and have a solid root mass per ANSI standards to hold the soil ball intact. If root mass is undersized the plant shall be rejected. 1 gallon container plants shall also have a minimum of 6" vertical height.

2.6 MULCHES

- A. Double Shredded Hardwood Mulch shall be used in planting beds as indicated on plans:
 - 1. Locally obtained or a proprietary product.
 - 2. Shredded hardwood mulch as approved by the Owner and/or Owner's Representative. No artificially colored mulch will be accepted.
 - 3. Provide 1.5" depth in all plug planted areas, 3" depth in perennial/ornamental grass planting beds and 4" depth at tree plantings.

2.7 WEED BARRIER & WEEDING

- A. Provide a chemical base weed prevention plan for all planting beds. Apply once installation is complete.
- B. Provide a Typar 3 ounce black premium professional landscape fabric or approved equal under all rock mulch areas. Submit product information for approval.
- C. Contractor shall be responsible for weeding of vegetated areas through warranty period.

2.8 STAKING MATERIALS

- A. Stakes for tree support shall be steel "T" bar fence post, 6' long, painted dark green with the top 6" painted white.
- B. Hose shall be reinforced garden hose no less than ½" inside diameter or fabric straps or other material approved by the Owner and/or Owner's Representative. Provide hose of adequate length to prevent contact of staking or guying wire with tree trunk.

- C. Provide wire of sufficient gauge to resist breaking during high winds.

2.9 BED EDGING

- A. Provide Spade Cut Edge as indicated on plans.

2.10 WATER

- A. Water shall not contain elements toxic to plant life. It shall be the Contractor's responsibility to obtain water to be used for a temporary watering system of plant material. The Contractor shall coordinate with the Owner to locate the best area for water connection.
- B. Provide temporary watering through the growing season to establish plant material and as needed through the warranty period to keep plant material in a thriving and healthy condition.
- C. The transition of maintenance responsibilities shall be summarized by the Contractor and provided in written form to the Owner once the Contractor has fulfilled work requirements to ensure watering and maintenance care keeps plants in a thriving condition.

PART 3 EXECUTION

3.1 GENERAL PREPARATION

- A. Protection of Existing Vegetation
 - 1. All areas under drip lines of existing trees shall be kept free of construction equipment, trailers, material storage, and vehicles.
 - 2. Exercise extreme care when working around existing trees to remain. No soil scarification or compaction from construction vehicles shall occur under any existing critical root zone.
- B. Clearing
 - 1. All planting bed areas and areas of turf establishment are to be cleared by the Contractor.
 - 2. Clearing shall consist of the satisfactory removal and disposal of brush, rubbish, and other vegetative growth occurring within all proposed turf and planting bed areas unless turf is being overseeded. All debris associated with this work shall be gathered and removed from the project by the Contractor.

3.2 TREE, SHRUB, AND PERENNIAL INSTALLATION

- A. All planting shall be performed by personnel familiar with the accepted procedure of planting and under the constant supervision of a qualified planting foreman.
- B. All planting is to be done as shown on drawings and as specified herein and in strict accordance with standard horticultural practices.
- C. Preparation of Planting Mixture and Beds
 - 1. Plant material locations and planting bed outlines shall be staked on the project site by the Contractor and approved by the Owner and/or Owner's Representative before any plant pits or beds are excavated. Plant material locations and bed outlines may be adjusted by the Owner and/or Owner's Representative to meet field conditions.
 - 2. Mix recommended soil amendments and fertilizers with topsoil at recommended rates. Delay addition of fertilizer if planting mixture will not be used within two (2) days.
 - 3. Planting beds shall be cultivated to a minimum depth of 12".

4. The Contractor shall be responsible for testing percolation rates to measure adequate drainage in the planting area. Where trees, shrubs, or perennials are planted a test bed shall be prepared with the location selected by the Owner and/or Owner's Representative. A percolation test shall be conducted by filling a 16" deep planting hole with water and measuring the time it takes for the water to drain. Adequate drainage will be considered equal to or greater than a percolation rate of $\frac{1}{2}$ " per hour. In case of inadequate drainage, the Owner and/or Owner's Representative shall be notified. Beds shall be free of rocks larger than one inch diameter, weeds, scrap material, and objectionable materials. Beds shall also demonstrate proper incorporation of soil additives.
- D. Installation of Trees, Shrubs and Perennial.
1. Planting pits shall be excavated to produce vertical sides and flat bottoms. Scarify side walls to alleviate glazing and loosen any hard subsoil in bottom of pit. Minimum pit sizes shall be as shown on drawings.
 2. Dispose of all subsoil, clay, and rock (off-site) removed from planting excavations. The top six (6) inches of topsoil excavated from the planting pit, if free from subsoil, clay, rocks, roots, or other debris, may be utilized in the topsoil mixture as specified.
 3. Setting Plants
 - a. The Contractor shall install the first balled and burlapped tree with the Owner and/or Owner's Representative present to ensure proper planting methods. Refer to planting details and specifications for the proper planting procedure of hole preparation and removal of all twine, wire cage and other trappings of the root ball. Root ball crowns shall also be set so that they are no more than 2" above grade to ensure the root flare is slightly above grade.
 - b. Balled and burlapped and container grown plants shall be handled and moved only by the ball or container. Remove all the wire cage and burlap except for 1/3 of the bottom before placing root ball in the ground. Inspect rootball to ensure specifications are met in Section 2.4. Plants shall be set plumb and held in position until a sufficient quantity of planting soil mixture has been firmly placed around roots or ball. Once the tree is stabilized in the planting hole, **carefully remove remaining burlap, twine, and all other trappings before partially backfilling.** Trees shall be watered in allowing water to completely soak into ground after partial backfill.
 - c. The remainder of backfill of planting soil mixture shall be tamped and watered.
 - d. Container-grown stock shall be removed from containers without damaging plant or root system. Planting shall be completed as specified for balled or burlapped plants.
 4. Double Shredded Hardwood Mulching
 - a. Mulch for plug areas shall be (1.5") and for planting beds shall be installed to a minimum depth of three inches (3") unless otherwise noted on the drawings. Mulch for all tree plantings shall be (4") in depth.
 - b. Mulching shall take place within 48 hours after planting.
 - c. Mulch shall be kept out of the crowns of shrubs and off walls, sidewalks, light standards, and other structures.
 - d. The top of all areas of mulch cover shall be 1" below the top of adjacent curb, walk, wall, wall cap, or edge of pavement.

- e. Mulching shall be considered incidental to the overall project. No additional compensation shall be allowed.
- 5. Staking and Guying
 - a. Plants shall be staked and guyed as indicated on plans within 24 hours of planting.
 - b. Stakes shall be driven vertically into the ground to a depth specified in details and in such a manner as not to damage the ball or roots.
 - c. All deciduous trees greater than two and one half inches (2 1/2") caliper shall be staked with three metal "T" stakes, spaced equal distant around the tree.
 - d. All evergreen trees shall be staked with two metal "T" stakes, spaced on either side of the tree.
 - e. Staking and guying shall be considered incidental to the overall project. No additional compensation shall be allowed.
- 6. Pruning: The Contractor shall prune new plant material in the following manner: Dead and broken branches shall be removed. Evergreen plants shall not be thinned out or sheared. Shrubs shall not be sheared. All plants shall meet or exceed the minimum requirements indicated in the size, condition, and remarks sections of the planting legend on the plan sheets after pruning has taken place. Cuts shall be made with sharp instruments and shall be in compliance with ANSI A300 Pruning Standards. "Headback" cuts at right angles to line of growth shall not be permitted. All trimmings shall be removed from the site.
 - a. Pruning shall be considered incidental to the overall project. No additional compensation shall be allowed
- 7. Wrapping: The Contractor shall wrap trees in the fall to help prevent sun scald and frost cracks unless otherwise directed by Owner and/or Owner's Representative. 4 inch wide bituminous impregnated tape, corrugated or crepe paper, specifically manufactured for tree trunk wrapping, having qualities to resist insect infestation, or similar material approved by the Owner and/or Owner's Representative. Wrapping shall overlap about 33 percent with each turn and fastened with twine. All wrap and twine shall be removed in spring.
- 8. Watering: The Contractor is responsible for maintaining adequate, but not excessive, soil moisture for plants installed. Watering must respond to varying seasonal conditions, soil types, and drainage. Water must thoroughly soak the entire root area rather than dampen the soil surface.
- 9. Initial inspection of the planting to determine completion of contract work, exclusive of possible replacement of plants, will be made by the Owner and/or Owner's Representative upon completion of the work. All plants shall be alive, healthy and in a vigorous growing condition at the time of initial acceptance. The Contractor shall notify the Owner and/or Owner's Representative when initial installation is complete.

3.3 INSTALLING MULCH

A. Mulching

- 1. The top of all areas of mulch cover shall be 1/2" below the top of adjacent curb, walk, wall, limestone edger, wall cap, or edge of pavement. Chemically treat beds once installation is complete.

2. Weed prevention and mulching shall be considered incidental to the overall project. No additional compensation shall be allowed.

3.4 MAINTENANCE

- A. Begin immediately following installation of plant material and continue until Owner's Representative issues the Notice of Acceptance. Contractor retains responsibility for maintenance during the period between the punch list inspection and completion of any punch list items. The Owner will only assume maintenance responsibilities upon issuance of Notice of Acceptance or Notice of Conditional Acceptance, if applicable.
- B. Include weeding, watering, re-mulching, resetting to proper grades and other related operations.
- C. Contractor shall be responsible for effective chemical or mechanical weed control from the time they move on site until Owner's Representative issues the Notice of Acceptance. At no time shall weeds in plant beds be allowed to grow over one foot in height or produce seeds. All cut or pulled weeds shall be removed from site and disposed of properly.

3.5 ACCEPTANCE

- A. Planting acceptance shall be based upon the following criteria:
 1. All requirements for the completed installation and maintenance have been provided.
 2. Clean-up operations are completed.
 3. All required submittals have been received by the Owner, including maintenance instructions.
 4. Plants shall be well-branched and well-formed alive, healthy, and in a vigorous growing condition at the time of acceptance.
- B. Seven (7) calendar days prior to the anticipated date of punch list inspection, submit written notice requesting inspection to the Owner's Representative.
- C. The Owner, Contractor, and Landscape Architect will complete a punch list inspection of the landscape to determine completion of contract work. Punch list inspection will not be conducted unless all items of work as outlined in PART 3 - EXECUTION have been completed.
- D. After the punch list inspection, the Contractor will be notified in writing by the Owner's Representative, of any deficiencies in the requirements for completion of the work.
- E. The Contractor will complete/resolve all of the items on the punch list and submit written notice requesting follow up inspection to the Owner's Representative seven (7) calendar days prior to the anticipated date of a follow up inspection.
- F. The Owner, Contractor, and Landscape Architect will complete a follow up inspection of the landscape to determine completion of all punch list items. If all items are complete, the Owner's Representative will issue a written Notice of Acceptance. If not, the Contractor will be notified in writing by the Owner's Representative, of any remaining deficiencies in the requirements for completion of the work and another follow up inspection will be scheduled. The Landscape Architect will perform no more than two inspections to determine whether the Work or a designated portion thereof has attained Final Completion in accordance with the Contract Documents. The Owner is entitled to reimbursement from the Contractor for the amounts paid to the Landscape Architect for any additional inspections.
- G. At the time of the Notice of Acceptance, the 1 year warranty inspection will be scheduled by the Owner's Representative.

3.6 PARTIAL AND CONDITIONAL ACCEPTANCE

- A. There may be instances where the Contractor and Owner agree that a specified portion of the site should undergo the punch list inspection process with the intent of the Owner granting acceptance of that portion of the site, occupying it for the Owner's use and accepting maintenance responsibilities. This constitutes a Partial Acceptance.
1. The process for completing the punch list inspection and issuance of the Notice of Partial Acceptance is the same as described in Section 3.5 but only applies to that portion of the site as agreed to by the Owner and Contractor.
 2. An exhibit with the boundaries of the partial acceptance clearly illustrated will be prepared by the Owner's Representative and will be attached to the Notice of Acceptance.
 3. Upon issuance of the Notice of Acceptance, the Owner will assume maintenance responsibilities for that area of the site and the one year plant warranty period will begin for all plants within the defined area.
 4. By implication, the remainder of the work must undergo the same process once judged to be complete by the Contractor and another Partial Acceptance must be achieved.
- B. There may be instances where the Contractor may choose to seek Conditional Acceptance of the work or portions of the work. This would apply to instances where plants have been installed but for some reason do not meet all of the requirements of the specifications such as a variance in size or the plant material was installed outside the approved planting dates. In these instances, the Owner may choose to grant the Conditional Acceptance with the understanding that the plant material will be re-assessed at a future date and either fully accepted or rejected.
1. This provision will only be allowed at the discretion of the Owner and should be used only in extremely unusual circumstances. This provision is not included to allow or encourage the Contractor to install plant material outside the approved planting dates.
 2. The process for completing the punch list inspection and issuance of the Notice of Conditional Acceptance is the same as described in Section 3.5 but only applies to the specific portions of the work as agreed to by the Owner and Contractor. The process for achieving Acceptance for the remainder of the work should be proceeding in parallel with this process.
 3. An exhibit clearly defining which portions of the work are included will be prepared by the Owner's Representative and will be attached to the Notice of Conditional Acceptance. The Notice will also clearly set a date by which a follow up inspection will be made.
 4. Upon issuance of the Notice of Conditional Acceptance, the Owner may or may not assume maintenance responsibilities for that portion of the work. This is a detail that will need to be worked out between the Owner and Contractor and will be documented in the Notice of Conditional Acceptance.
 5. On or before the date specified in the Notice of Conditional Acceptance, the Owner, Contractor, and Landscape Architect will complete a follow up inspection to determine if the work in question meets the requirements for acceptance.
 - a. If so, the original Notice of Acceptance for the remainder of the site will be amended to include the work in question and beginning date of the warranty period for those plants shall be deemed to be the same as the remainder of the project.

- b. If not, the contractor shall follow the same procedures for rectifying the non-compliant work and re-inspection as outlined in Section 3.5. Once the work has been corrected and verified, a Notice of Partial Acceptance will be issued for that portion of the work and the one year plant warranty period will begin for all plants included in that portion of the work.

3.7 WARRANTY AND REPLACEMENT

- A. Plant material shall be warranted for 1 full year after issuance of the Notice of Acceptance and shall be alive, in good health, and in satisfactory condition at the end of warranty period.
- B. Any plant required under this Contract that is dead or not in a vigorous, thriving condition, as determined by the Owner's Representative at the time of warranty inspection, will be removed from the site.
- C. The Owner, Contractor, and Landscape Architect will complete a warranty inspection of the landscape.
- D. After the warranty inspection, the Contractor will be notified in writing by the Owner's Representative, of any deficiencies or required replacements.
- E. The Contractor will complete/resolve all of the items on the warranty inspection and submit written notice requesting follow up inspection to the Owner's Representative seven (7) calendar days prior to the anticipated date of a follow up inspection.
- F. The Owner, Contractor, and Landscape Architect will complete a follow up inspection of the landscape to determine completion of all warranty items. If all items are complete, the Owner's Representative will issue a written Notice of Warranty Fulfillment. If not, the Contractor will be notified in writing by the Owner's Representative, of any remaining deficiencies in the requirements for completion of the work and another follow up inspection will be scheduled.
- G. Plants that are missing at the time of warranty inspection are to be installed during the specified planting season when weather and site conditions permit.
- H. After Notice of Acceptance, the Contractor shall replace plants (once during or at the end of the warranty period) that are observed to be dead or in a badly impaired condition. One replacement after Notice of Acceptance shall constitute fulfillment of Contractor's warranty for the particular plant replaced. Plants replaced during the punch list process are considered to be part of the fulfillment of the requirements of the Contract and are not part of the warranty.
- I. Replacement Plants: Plants of the same kind and size as specified in the Plant Schedule; furnished and planted as specified herein. Guyed or staked, mulched, fertilized, pruned, and restored to original condition as originally specified at no cost to Owner.
- J. Replacement cost shall be borne by Contractor except for possible replacements resulting from loss or damage due to occupancy at project in any part, vandalism, civil disobedience, and acts of neglect on the part of others, physical damage by animals, vehicles, fire, or losses due to curtailment of water by local authority, or to "Acts of God". Droughts, floods, tornadoes, winds of hurricane force, and hail are not normal and the damage they do cannot be calculated in a bid.

3.8 EXTENDED MAINTENANCE -BID ALTERNATE #3

- A. Provide extended landscape maintenance for a period of not less than one (1) year following the date of issuance of the Letter of Substantial Completion as specified below:
1. General Landscaping: Landscape maintenance shall include necessary watering, cultivation, weeding, pruning, wound dressing, disease and insect pest control, protective spraying, straightening plants, which lean or sag, adjustments of plants which settle or are planted too low, replacement of mulch or rock mulch that has been displaced, repairing and reshaping of saucers, and replanting of those areas affected. Remove rubbish, waste, tools, and equipment used at end of each workday.
 2. Watering:
 - a. The Contractor may install a temporary irrigation system at his/her expense to keep plants in thriving condition. Contractor shall furnish hoses and other watering equipment as required for supplemental watering. Coordinate with Owner for water connections.
 3. Weeding: Maintain all shrub and groundcover areas free from weeds and undesirable grasses. Hand-pull any weeds in mulch.
 4. Disease and insect pest control: Inspect plant material at least once each month to locate any disease or insect pest infestations. Upon discovery of infestation, nature or species of infestation shall be identified. Spray or treat as required to keep trees and shrubs free of insects and disease.
 5. Pruning and Repair: Prune as required to remove dead or injured branches, to compensate for loss of roots as result of transplanting operations, and to maintain safety in traveled areas. Pruning shall not change the natural habit or attractive, balanced shape of plant. Cuts shall be made at the outside edge of the branch collar.
 6. Mowing is not required as part of the extended maintenance.

END OF SECTION

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**SECTION 32 9200
SEEDING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This part of the Specifications includes providing labor, materials, equipment, and supervision required to provide seeding.
- B. Per plan L101, there are a variety of zones where the Owner will provide and/or install seed. The contractor is required to provide seed bed preparation in all zones.

1.2 RELATED SECTIONS

- A. Section 32 9100 Landscape Planting
- B. Section 32 9300 Sodding

1.3 QUALITY ASSURANCE

- A. Seeding is to be installed by a firm specializing in seeding as specified.
- B. Source Quality Control: Ship seeding materials with certificates of inspection required by governing authorities. Comply with regulations applicable to seeding materials.
- C. Do not make substitutions. If specified material is not obtainable, submit proof of non-availability to Owner's Representative, together with proposal for use of equivalent material.
- D. Analysis and Standards: Package standard products with manufacturers certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.

1.4 SUBMITTALS

- A. Seed vendor's certified statement for each grass seed mixture and native plugs required, stating botanical and common name, percentages by weight, recommended application rates, and percentages of purity, germination, and weed seed for each grass seed species.
 - 1. Submit method of installation for approval.
- B. Fertilizer: Submit certification of the fertilizer analysis with scale weight and statement of guaranteed analysis. Submit from a certified fertilizer dealer, a mechanically printed commercial fertilizer label, or bill of lading. Comply with the inspection and acceptance requirement of Iowa DOT Materials I.M. 469.03.
- C. Erosion Control Blanket: Submit product data
- D. Seeding Schedule: Proposed seeding schedule, indicating dates for seeding work during normal seasons. Once accepted, revise dates only as approved by Owner's Representative in writing, after documentation of reasons for delays.
- E. Provide shop drawing for the planting of the bio-cells.
- F. Dates for this work are as follows:
 - 1. Spring: April 15 - June 15
 - 2. Dormant Seed: December- March

3. Any deviations from this schedule must be approved by the Owner's Representative. Maintenance and warranty conditions may be impacted by such deviation.
4. Furnish detailed written recommended maintenance program to the Owner with a copy to the Owner's Representative, prior to final inspection of the seeding.

1.5 DELIVERY, STORAGE AND HANDLING

- A. If seed is mixed prior to delivery on the site, it shall be tagged showing a guaranteed statement of composition of mixture and percentage of purity and germination of each variety.
- B. If seed is to be mixed at the site, it shall be delivered in original containers bearing producers certification of germination and purity.
- C. Tags shall show producers or dealers Iowa Permit Number and date of testing; test date shall be no more than 90 days previous to time of use.
- D. Fertilizers shall conform to State of Iowa laws and regulations. If delivered in bulk, bills of lading or other labels shall be furnished to the Engineer or labels indicating analysis and weight information from each container shall be preserved and furnished to the Engineer within twenty-four (24) hours of application.
- E. Handling of materials as recommended by manufacturer.
- F. Store all packaged materials off ground and protect from moisture.
- G. Storage of all materials in locations designated and approved by Owner's Representative.

1.6 JOB CONDITIONS

- A. Utilities: Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, as required.
- B. Grade Stakes: Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.
- C. Protection: Protect existing irrigation system, structures, utilities, sidewalks, pavements, and other facilities during seeding operations. Repair any damage at no cost to the Owner.

1.7 SEQUENCING AND SCHEDULING

- A. Planting Time: Proceed with, and complete seeding as rapidly as portions of site become available, working within seasonal limitations for each kind of seed required. Contractor shall seed to allow proper germination within a 7-10 day period free from heavy rainfalls. The establishment of the seed will be critical in the detention area. Prevention of ponding to allow seed to establish may be required.
 1. Chronological procedure for seeding is to remove any existing vegetation, disc, fertilize, prepare the seed bed, seed, and water.

PART 2 PRODUCTS

2.1 SEEDING MATERIALS

- A. Native Grasses Seed: Owner shall provide and install. Contractor is responsible for seedbed preparation.

B. Biocell Native Plugs: See L101 for a list of plugs to be provided:

1. March-Oct: Annual Rye at 15 lbs/acre
2. Nov-Feb: Winter Wheat at 50 lbs/acre

2.2 SEEDING

A. Prior to seeding, the seedbed will be inspected and approved by the Owner. Use methods and procedures consistent with equipment manufacturer's recommendations; however, do not operate ground-driven equipment at speeds greater than 10mph.

B. Sow seed mix at specified rates, lbs/acre.

2.3 WATERING

A. Provide temporary watering for seeded areas. Use enough water to keep the soil and mulch moist to a depth of 1 inch and ensure growth of the seed. For turfgrass seeding areas, sufficiently water to keep the soil moist for a minimum of 21 days.

1. Water shall be provided by owner.

B. Adjust watering per approval of owner based on temperature, wind and natural rainfall.

2.4 MAINTENANCE

A. Begin immediately following installation.

1. Mow twice in spring once grass is 6"-8" tall and mow once every month for the first year to minimize weeds and according to seeding technical bulletin.
2. Mow once in spring the second growing year
3. To include:
4. Repair of eroded or damaged areas prior to acceptance.
5. Until initial acceptance and approval is received, reseed or overseed, using seed mix originally specified. All seeded areas shall produce uniformity.

2.5 REPAIR OF SEED AREAS

A. Repair disturbed areas for seeding by tilling, shaping, and raking as required.

2.6 CLEANUP AND PROTECTION

A. During seeding work, keep pavements clean and work area in an orderly condition. Clean all paved surfaces open for public use at the end of each day and prior to forecasted precipitation.

B. Upon completion of job, clean-up all debris, caused by work, and excess material and leave area within contract limits in a neat and clean condition.

2.7 INSPECTION AND ACCEPTANCE

A. Upon completion of the work and fulfillment of the requirements of this Section, notify the Owner's Representative in writing that the work is ready for final inspection. Request a definite date for final inspection that is no sooner than 60 days from the date that all activities were completed.

B. Notify the Owner's Representative five (5) days prior to the requested final inspection date.

C. Acceptance Requirements:

1. Seeded areas shall be in a live, healthy, growing, and well-established condition without eroded areas, bare spots, weeds, undesirable grasses, disease, or insects.
2. Seeded areas shall have a dense uniform stand of grass growing not less than 95 percent of the overall area and with no individual bare spots larger than 3 inches in size and no concentrations of bare spots.
3. Reseed and maintain all seeded areas which do not meet the requirements of this Section at the time of final inspection.
4. Replacement work shall be as specified for original seeding.
5. Replacement work shall be re-inspected before acceptance.
6. Replacement cost shall be borne by Contractor except for possible replacements resulting from loss or damage due to occupancy at project in any part, vandalism, civil disobedience, acts of neglect on the part of others, physical damage by animals, vehicles, fire, or losses due to curtailment of water by local authority, or to "Acts of God". Droughts, floods, tornadoes, winds of hurricane force, and hail are not normal and the damage they do cannot be calculated in a bid.

END OF SECTION

**SECTION 32 9300
SODDING**

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. This part of the Specifications includes providing labor, materials, equipment, watering, and supervision required to provide sodding.

1.2 RELATED SECTIONS

- A. Section 32 9100 - Landscape Planting.
- B. Section 32 9200 - Seeding

1.3 PROTECTION OF PROPERTY

- A. Protect Existing Conditions at the site against damage including the following:
 - 1. Take precautions to ensure that equipment, vehicles, and planting operations do not disturb or damage existing grades, walls, drives, pavement, utilities, plants, lawns, irrigation systems, and other facilities.
 - 2. Verify locations and depths of all underground utilities prior to excavation and report conflicts with grade or sod operations.
 - 3. Any damage to existing trees or shrubs, including branches, and root systems to remain and protect shall be repaired and/or pruned by an approved, experienced tree surgeon or arborist.
 - 4. Repair, replace, and/or return to original condition any damaged item, without additional compensation.

1.4 SUBMITTALS

- A. Submit product type, supplier, and sod growers certification of grass species and location of sources for approval.
- B. Submit certification of the fertilizer analysis.
- C. Submit written maintenance instructions to Jurisdictional Engineer recommending procedures for maintenance of sodded lawns, prior to final acceptance of sodded lawns.
- D. Upon request the Contractor will provide Material Certifications to the Jurisdictional Engineer.

1.5 QUALITY ASSURANCE

- A. All materials described and specified herein as delivered to the project site shall be subject to inspection and approval by the Jurisdictional Engineer.
- B. This inspection does not waive the right to reject any material after it has been delivered to the site and/or installed.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Sod shall be harvested, delivered, and transplanted within a period of 24 hours unless a suitable preservation method is approved by the Jurisdictional Engineer prior to delivery.
- B. Do not harvest or transport sod when moisture content may adversely affect sod survival.

- C. Protect sod from sun, wind, dehydration, and rain prior to installation that cannot be placed immediately on delivery.
- D. Sod showing visible signs of heating or dehydration will be rejected.
- E. Do not tear, stretch, or drop sod during handling and installation.
- F. Deliver fertilizer to site in original, unopened, and non-damaged containers, each bearing manufacturer's guaranteed analysis.
- G. Store packaged materials off ground and protect from moisture and deterioration.

1.7 SCHEDULING

- A. Notify Engineer/Architect at least three days prior to start of sodding operations.
- B. Perform sod installation after planting and other work affecting ground surface has been completed, or as approved by Engineer/Architect.
- C. Contractor shall be responsible for watering and establishment for establishment periods.

1.8 WARRANTY

- A. The warranty is to guarantee completed sodding operations providing a uniformly dense, live, and healthy stand of grass, free of weeds and undesirable grasses, debris, and free of eroded areas, bare spots, diseases, and insects at the end of one year following the minimum maintenance period.
- B. Contractor to replace as originally specified areas which have failed to survive, as often as required, to establish the sodded lawn area until accepted; at no additional compensation.
- C. Repair and replace to original condition all damages to property resultant from the sodding operation and all damages as a result from the remedying of these defects, without additional compensation.

PART 2 – PRODUCTS

2.1 SOD

- A. Sod grown in peat bedded soil is not acceptable.
- B. Sod: Kentucky Blue Grass Certified sod.
 - 1. Blue Grass Enterprises 3965 C Ave Ext. Alburnett, IA 319.842.2165 or approved equal.
- C. Sod shall be free of objectionable grasses and broadleaf weeds; sod shall be considered free of such weeds if less than two such plants are found per 100 square feet of area. Sod shall be free from roots of trees or shrubs, stones, thatch, and other objectionable materials. Sod shall be free of nematodes and soil born insects and free of disease.
- D. Mow at height of 2" prior to cutting. Sod to be machine cut at uniform soil thickness of approximately 1" thickness measurement shall exclude top growth.
- E. Sod shall be cut with a sod machine in strips of uniform width and lengths with ends square standard to the industry.
- F. Sod shall be moist when placed.

2.2 FERTILIZER

- A. Fertilizer shall comply with the rules of the Iowa Department of Agriculture and as follows:
1. The grade of fertilizer will be identified according to the percent nitrogen (N), percent of available phosphoric acid (P₂O₅), and percent water soluble potassium (K₂O), in that order, and approval will be based on that identification.
 2. All fertilizer shall be furnished from an established fertilizer dealer and guaranteed percentage analysis shall be provided by the fertilizer supplier on each container with the proper scale weight records.
 3. Fertilizer shall be of a type that can be uniformly distributed by the application equipment. Fertilizer may be furnished in a dry (granular) or liquid form.
 4. When applied dry, the fertilizer shall be a granular, non-burning chemically combined product composed of not less than 50% organic slow acting, guaranteed analysis professional fertilizer. Granular or pellet form shall be uniform in composition, dry, and free flowing without caking or other damage not suitable for use.
 5. When applied in a liquid form, fertilizer may be chemically combined or may be furnished as separate ingredients.
 6. Upon request of the Contracting Authority, the Contractor shall provide a test of the fertilizer for conformance with the required analysis at no additional compensation; a tolerance of 1.0 percentage point plus or minus will be considered substantial compliance.

2.3 STAKES

- A. Softwood Stakes: 3/4" diameter and 8" long, or.
B. Steel, Tee Shaped Pins: 4" head and 8" leg.

2.4 WATER

- A. Water shall be free of substance harmful to sod growth.
B. Contractor to provide water, equipment, methods of transportation, water tanker, hoses, sprinklers, and the application of water.

PART 3 – EXECUTION

3.1 PREPARATION OF BID

- A. Limit preparation to areas which will be immediately sodded.
B. Where weed growth has developed, remove all weeds and weed debris. Weed growth removal process to be approved by Jurisdictional Engineer, without additional compensation.
C. Contractor shall shape and fine grade to remove washes or gullies, water pockets, and irregularities to a smooth, firm, and even surface true to grade and cross-section.
D. Rototill and cultivate sod bed to a minimum 3" depth to a fine and mellow condition. Clear the top 3" of soil lumps, stones over 3/4", and foreign material using hand labor as required.

3.2 FERTILIZING - FIRST APPLICATION

- A. Provide a guaranteed analysis of 20-26-6 commercial fertilizer or the equivalent units of nitrogen (N), phosphate (P), and potash (K) by weight at the rate of 200 pounds per acre.
B. Incorporate fertilizer into soil to a depth of 1-1/2" prior to sodding.

3.3 SOD INSTALLATION

- A. Sod shall not be installed between the dates of June 15 to August 15, unless authorized by Jurisdictional Engineer.
- B. Lay no sod on frozen soil nor with eminent freezing conditions within 24 hours.
- C. Do not lay dormant nor frozen sod.
- D. Dampen dry soil prior to sodding.
- E. Sod shall be carefully placed in rows or strips evenly and with longest joint parallel to the finished contours and at right angles to the center line of ditches and channels. On slopes, sodding shall begin at the bottom and progress upward.
- F. Minimize traffic on newly laid sod during installation. Provide plank or wood sheets as may be required to protect sod already laid, without extra compensation during sodding operations.
- G. Lay each strip with tightly fitted joints against each other without voids. Do not overlap edges. Joints at the ends of sod strips shall be staggered with adjacent strips of sod.
- H. Finish sod edges at walks, curbs, planting, mulch edges, and other vertical surface by cutting neatly and fitting tightly to edge and line.
- I. Sod mat to be approximately 1 inch below finished height of walks, pavement, curbs, etc. Any sod not conforming to this requirement will be removed, the subgrade adjusted, and the sod re-laid.
- J. Where new sod joins existing lawns, cut straight and neatly into existing lawn and level subgrade to allow height to match.
- K. Stake sod on grades exceeding 4:1 and in drainage channels. Stake each roll at minimum two foot intervals to prevent movement under rainfall conditions.
- L. Soil shall be firmed or healed in along the edges of the sodded areas.
- M. Roll sod that has been lightly watered with small mechanical or hand roller to sufficiently set or heal sod into soil and remove lumps. Roll as required to firm and level the sodded areas.

3.4 WATERING

- A. Not more than one hour shall elapse between the laying and initial watering of the sod.
- B. Initial watering shall provide a thoroughly wet sod and sod bed.
- C. Water all sodded areas during maintenance period as necessary to maintain sod and soil moisture, supplement rainfall, to promote growth, proper rooting to ensure sod survival, and to prevent dormancy.
- D. Apply water uniformly and consistently on all sodded areas to prevent damage to sod and existing or recently planted trees and shrubs.

3.5 FERTILIZING – SECOND APPLICATION

- A. Apply second application of fertilizer with a guaranteed analysis of 10-10-10 commercial fertilizer or the equivalent units of nitrogen (N), phosphate (P), and potash (K) at the rate of 300 pounds per acre two weeks after laying sod and prior to final acceptance.

3.6 MAINTENANCE

- A. Begin maintenance immediately following installation of sod and continue for a period until sodded areas are established with sod knitted in place. Maintenance period shall be 30 days.

- B. Maintenance of sodded areas shall include watering, weeding, mowing to a 2 - 2 1/2" height after growth has exceeded 3" and prior to a 4" growth, and replacement and installation of sod as originally specified for sodded areas failing to survive. Clippings from mowing which mat on the grass, are to be removed.

3.7 CLEAN-UP

- A. Perform cleaning during installation of work and upon completion.
- B. Remove from site all excess materials, debris, and equipment.
- C. Hose down and/or broom clean all paved surfaces.
- D. Repair any damage resulting from sodding operations.

3.8 ACCEPTANCE

- A. Sod acceptance shall be based upon the following criteria:
 - 1. All requirements for the completed installation and maintenance have been provided.
 - 2. Sodded areas are healthy, even colored viable lawn is established, free of weeds, undesirable grass species, disease, and insects.
 - 3. Sod is "knit down" to the soil so that it cannot be pulled up.
 - 4. Sodded areas are without scattered bare spots, dead or dormant sod.
 - 5. Clean-up operations are completed.
- B. Replacement sod work shall be re-inspected in accordance with A. above before acceptance.

END OF SECTION