

Exhibit-B: Specifications, dated January 06, 2025



IMAGINATION CENTER AT REINDAHL PARK

BID DOCUMENTS: SPECIFICATIONS

JANUARY 6, 2025 | CONTRACT #9610 | MUNIS #17085



JLA
ARCHITECTS

MADISON | MILWAUKEE | DENVER

**SECTION 00 01 01
PROJECT TITLE PAGE**

PROJECT SPECIFICATION MANUAL

**IMAGINATION CENTER AT REINDAHL PARK
MADISON, WISCONSIN**

JLA PROJECT NUMBER: 20-0928-02

FOR: CITY OF MADISON ENGINEERING DIVISION

CONTRACT NO. # 9610 ; MUNIS NO 17085

PROJECT LOCATION:

LIBRARY: 1814 PARKSIDE DRIVE

PAVILION: 1818 PARKSIDE DRIVE

MADISON , WISCONSIN

BID DOCUMENTS

DATE: JANUARY 6, 2025

PREPARED BY:

JLA ARCHITECTS

**SECTION 00 01 02
PROJECT INFORMATION**

PART 1 GENERAL

1.01 PROJECT IDENTIFICATION

- A. Project Name: Imagination Center at Reindahl Park
Library: 1814 Parkside Drive.
Pavilion: 1818 Parkside Drive
Madison, Wisconsin 53704.
- B. Architect's Project Number: 20-0928-02.
- C. Owner's Project Number: MUNIS NO 17085.
- D. The Owner, hereinafter referred to as Owner: City of Madison Engineering Division
- E. Additional Stakeholders:
 - 1. Madison Public Library.
 - 2. Madison Parks - City of Madison Parks Division.

1.02 PROJECT DESCRIPTION

- A. Summary Project Description: 17,468 square foot single-story public library and community center on an 87.315 acre site. This is a multi-agency collaborative effort to serve the residents of northeast Madison, Wisconsin.
- B. Contract Scope: Construction and demolition.
- C. Contract Terms: Cost plus a fee, with a guaranteed maximum price (GMP).

1.03 PROJECT CONSULTANTS

- A. The Architect, hereinafter referred to as Architect: JLA Architects.
800 E. Broadway, Suite 200.
Monona, WI 53713.
Project Manager: Jennifer Camp, AIA
Phone: 608.241.9500.
E-mail: jcamp@jla-ap.com.

1.04 PROCUREMENT TIMETABLE

- A. Desired Construction Start: Thursday, April 3, 2025.
- B. Desired Substantial Completion Date: Not later than Thursday, September 3, 2026.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 00 01 03
PROJECT DIRECTORY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Identification of project team members and their contact information.

1.02 OWNER:

- A. Name: City of Madison Engineering Division
210 Martin Luther King, Jr. Blvd., #115
Madison, WI 53703-3342
- B. Primary Contact: All correspondence from the Contractor to the Architect will be through this party, unless alternate arrangements are mutually agreed upon at preconstruction meeting.
Brent Pauba.
Email: bpauba@cityofmadison.com.
Phone: 608.266.4092

1.03 CONSULTANTS:

- A. **Architect:** Design Professional of Record. All correspondence from the Contractor regarding construction documents authored by Architect's consultants will be through this party, unless alternate arrangements are mutually agreed upon at preconstruction meeting.
1. Company Name: JLA Architects.
800 E Broadway, Suite 200.
Monona, WI 53713.
Joseph M Lee, AIA
Phone: 608.241.9500.
 2. Primary Contact:
Senior Project Manager.
Jennifer Camp, AIA.
Email: jcamp@jla-ap.com.
Phone: 608.241.9500
- B. **Interior Design Consultant:**
1. Company Name: InteriorLOGIC, Inc.
1201 S. Stoughton Road, Suite 150.
Madison, WI 53716.
Web: www.intlogic.com
 2. Primary Contact:
CEO and Founder.
Robin A. Stroebe, ASID, RID, LEED AP ID +C, WELL AP.
Email: rstroebe@intlogic.com.
Phone: 608-316-3870
- C. **Civil Engineering Consultant:**
1. Company Name: Graef, Inc.
1010 East Washington Ave., Suite 202.
Madison, WI 53703.
 2. Primary Contact:
Amy Larson, PE.
Email: amy.larsen@graef-usa.com.
Phone: 608.245.1962

D. Landscape Architecture Consultant:

1. Company Name: Saiki Design, Inc.
1110 South Park Street.
Madison, WI 53715.
2. Primary Contact:
Christopher Sina, PLA, ASLA.
Email: csina@saiki.design.
Phone: 608.405.8162

E. Structural Engineering Consultant:

1. Company Name: Graef, Inc.
1010 East Washington Ave., Suite 202.
Madison, WI 53703.
2. Primary Contact:
Justin Bittenbender.
Email: justin.bittenbender@graef-usa.com.
Phone: 414.266.9033

F. Mechanical, Electrical, Plumbing, Fire Protection Engineering Consultant:

1. Company Name: Graef, Inc.
1010 East Washington Ave., Suite 202.
Madison, WI 53703.
2. Primary Contact:
Uriah Wolfe, P.E., SE, LEED-AP.
Email: uriah.wolfe@graef-usa.com.
Phone: 414.266.9083.

G. Acoustical Consultant or Acoustician:

1. Company Name: Thornton Tomasetti.
1701 Hollis Street, Suite 800.
Halifax, NS B3J 3M8.
Main: +1.905.271.7888.
2. Primary Contact:
Rudi Kroch, M.Eng .
Email: RKroch@ThorntonTomasetti.com .
Phone: +1.905.874.8332

H. Cost Estimator:

1. Company Name: Middleton Consulting & Contracting (MCC).
5600 North River Road, Suite 950.
Rosemont, IL 60018.
2. Primary Contact:
Josh Houston.
Email: josh@middleton-cc.com.
Phone: 631.678.7863

END OF SECTION

**SECTION 00 01 07
SEALS PAGE**

1.01 DESIGN PROFESSIONALS OF RECORD

- A. ARCHITECT:
 - 1. Joseph M. Lee, AIA.
 - 2. License Number: A-9483.
 - 3. Responsible for Sections in Divisions 01-33 except where indicated as prepared by other design professional of record.

- B. CIVIL ENGINEER:
 - 1. Amy Larson, P.E.
 - 2. License Number: 47139.
 - 3. Responsible for Divisions 31 and 33, and Sections:
 - a. 01 57 13; 32 11 23; 32 12 16; and 32 13 13.

- C. LANDSCAPE ARCHITECT:
 - 1. Abbie Moilien, PLA.
 - 2. License Number: LA-673.
 - 3. Responsible for Division 32, and Section 31 13 00
 - a. Excluding Sections: 32 35 00 and 32 94 47.13.

- D. STRUCTURAL ENGINEER:
 - 1. Steven Rech, P.E.
 - 2. License Number: E37947-6.
 - 3. Responsible for Divisions 03-05
 - a. Excluding Sections: 05 31 33.

- E. PLUMBING & FIRE-PROTECTION ENGINEER:
 - 1. Jessica Culver, P.E.
 - 2. License Number: 45768.
 - 3. Responsible for Division 21.

- F. HVAC ENGINEER:
 - 1. Matthew Garcia, P.E.
 - 2. License Number: 47626.
 - 3. Responsible for Division 23.

- G. ELECTRICAL ENGINEER:
 - 1. Beth Ann Bruss, D.E.S.
 - 2. License Number: D2317E.
 - 3. Responsible for Divisions 26, 27 and 28.

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[CoM] Denotes City of Madison section

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ARCHITECTURAL SITE

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T601	ELECTRICAL SCHEDULES

PART 2 - NOT USED**PART 3 - NOT USED****END OF SECTION**

**SECTION 00 31 46
PERMITS****PART 1 – GENERAL****1.01 SUMMARY**

- A. Each project has varying requirements for permits, inspections, and fees based on the scope, size, and location of the project.
- B. The City of Madison (Owner) is subject to all permits, inspections and associated fees for construction, demolition, utility connection, storm water management, and other similar requirements that may be required to complete the scope of work associated with these contract documents.
- C. The General Contractor (GC) shall be responsible for obtaining all permits, inspections and paying for all associated fees unless specifically identified within this specification.

1.02 REFERENCES

- A. The following references are not intended to be all inclusive. It shall be the GC's responsibility to determine all requirements based on the scope of work in the contract documents.
- B. City of Madison Ordinances: Review all ordinances that may require a permit or fee that may be connected with a required permit. Contact the following City Agencies to determine the exact requirements during bidding.
 - 1. Building Inspection.
 - 2. Zoning.
 - 3. Engineering.
 - 4. Water Utility.
 - 5. Traffic Engineering.
 - 6. Others as may be specified by the contract documents.
- C. State Statutes.
- D. Other Regulatory Regulations.
- E. Other Agencies or companies that may have related requirements
 - 1. Madison Metropolitan Sewerage District.
 - 2. Local gas and electric utility companies.
 - 3. Other utility companies.

1.03 GENERAL CONTRACTORS REQUIREMENTS

- A. The GC shall be responsible for all of the following:
 - 1. Execute application for all required permits as may be required by the scope of work described within the contract documents.
 - 2. Scheduling all required inspections that may be conditions of any required permits.
 - 3. Paying for other permits not explicitly stated as excluded in this section.
- B. The GC is not responsible for paying for the City Building, City HVAC, City Electrical, City Plumbing, Madison Fire Department Sprinkler and Madison Fire Department Fire Alarm permits.
- C. The GC shall provide high quality scanned images of all required permits and inspections and upload them to the Contract Documents-Regulatory Documents Library on the Project Management Web Site.

PART 2 – PRODUCTS – THIS SECTION NOT USED**PART 3 – EXECUTION – THIS SECTION NOT USED****END OF SECTION**

SECTION 00 43 25
SUBSTITUTION REQUEST FORM (DURING BIDDING)

PART 1 – GENERAL

1.01 SUMMARY

- A. The City of Madison uses a specific list of preferred products for various specification items to establish standards of quality, utility, and appearance required.
- B. The City of Madison will not allow substitutions for specified Products except as follows:
 - 1. The Product is no longer produced or the product manufacturer is no longer in business.
 - 2. The manufacturer has significantly changed performance data, product dimensions, or other such design criteria for the specified Product(s).
 - 3. Products specified by naming one or more Products or manufacturer's and "or approved equal" or "approved equivalent."
- C. The procedures in this specification shall apply to all proposals by Contractors, Suppliers, Vendors, and Manufacturers when the conditions in item 1.1.B. above have been met during the bidding phase.

1.02 RELATED SPECIFICATIONS

- A. 01 25 13 Product Substitution Procedures.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.01 REQUESTING A SUBSTITUTION DURING BIDDING

- A. In the event that a substitution is requested during the bidding phase the Contractor, Supplier, Vendor, or Manufacturer shall do all of the following:
 - 1. Submit a Substitution Request Form for each different product. Use a printed/scanned copy of the form at the end of this specification as a cover sheet.
 - 2. Support your request with complete data, drawings, specifications, performance data and samples as appropriate. A complete submission shall include the following:
 - a. Substitution Request Form as a cover sheet.
 - b. Comparison of qualities of the proposed substitutions with that specified.
 - c. Changes required in other elements of the Work because of the substitution.
 - d. Effect on the construction schedule.
 - e. Cost data comparing the proposed substitution with the Product specified.
 - f. Any required license fees or royalties.
 - g. Availability of maintenance service and source of replacement materials.
 - 3. Submit the Substitution Request Form and all required supporting documentation to the City Project Manager and Project Architect.
 - a. Submissions to be done as complete PDF files for each product, appropriately titled.
 - b. Email submissions to the Project Architect and City Project Manager at the email addresses provided on the last page of Section D of the contract documents.
 - 1) The subject line shall include the contract number and "Request for Substitution".
Example: Contract 1234 – Request for Substitution.
 - 4. Submissions must be received by the substitution request deadline specified in Section A of the Contract Documents.

3.02 SUBMISSION REVIEW

- A. The Project Architect, City Project Manager, members of the design team, and the Owners staff shall review all submissions for substitutions during the bidding phase.

3.03 SUBSTITUTION APPROVAL

- A. All requests for substitutions that have been approved shall be published by Addenda to the bid documents.

3.04 SAMPLE SUBSTITUTION REQUEST FORM

For Pre-bid Substitution Requests all text boxes on this form are required information for a complete request.

		<h2>Substitution Request</h2>	
Today's Date:		<input type="text"/>	
Project Title:		<input type="text"/>	
Project Number:		Contract Number: <input type="text"/>	
<p><i>By completing and submitting this form for review the General Contractor affirms that all of the following statements are correct:</i></p> <ol style="list-style-type: none">1 The General Contractor affirms that this request is in compliance with the requirements described in <i>Specification 01 25 13 Product Substitution Procedures</i>.2 The function, appearance, and quality of the proposed substitution are equal or superior to the specified item.3 The proposed substitution does not affect dimensions shown on the drawings.4 The proposed substitution will have no adverse affects on other trades, the construction schedule, or any specified warranty requirements.5 Maintenance and service parts will be locally available for the proposed substitution. (GC shall provide supporting documentation in the attachments section below.)6 The General Contractor shall be responsible for any and all costs associated with this substitution request if approved. This includes but is not limited to fees for building design, engineering design fees, detailing fees, plan review fees, construction costs, and inspection fees.			
GC Substitution Request:			
General Title:		<input type="text"/>	
Related Specification:		<input type="text"/> <input type="text"/> <input type="text"/>	
Reason for Substitution:		<input type="text"/>	
Proposed Substitution: (include Name, Model, etc.)		<input type="text"/>	
Submitted By:		Phone:	
<input type="text"/>		<input type="text"/>	
Company:		Email:	
<input type="text"/>		<input type="text"/>	

END OF SECTION

**SECTION 00 43 43
WAGE RATES FORM**

PART 1 – GENERAL

1.01 SUMMARY

- A. The Reimbursable Hourly Worksheet is a contractor provided document that indicates the basic rate of pay, fringe benefits, and each companies cost of required insurance for all Trades and Classifications that will be performing productive labor during the execution of this contract.
 - 1. Rates shall be similar to recognized rates published by the Bureau of Labor Statistics, Associated General Contractors (AGC), Associated Builders and Contractors (ABC), appropriate union contracts, and other similar organizations or documents.
- B. The Reimbursable Labor Rate Worksheet shall provide the basis for labor rates being used on Change Order Request forms.

1.02 RELATED SPECIFICATIONS

- A. Section 01 26 57 Change Order Request.
- B. Section 01 29 76 Progress Payment Procedures.
- C. Section 01 31 23 Project Management Web Site.
- D. Section 01 32 19 Submittals Schedule.

PART 2 – PRODUCTS – NOT USED

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Prior to the Pre-Construction Meeting the City Project Manager (CPM) or the City Construction Manager (CCM) shall provide the GC a copy of the Reimbursable Labor Rate Worksheet.xls.
 - 1. See the last page of this specification for an example of the worksheet.
- B. The GC shall provide all subcontractors that will be performing productive labor during the execution of this contract with additional copies of the worksheet as needed.
- C. All contractors shall be required to fill out and submit completed worksheets for all Trades and Classifications of labor that will be performing productive labor during the execution of this contract.

3.02 GENERAL CONTRACTORS RESPONSIBILITIES

- A. The GC shall consolidate all Trades and Classifications into one master Excel Workbook of all trades.
- B. The GC shall provide the combined workbook as required by Section 1.06 of Specification 01 32 19 Submittals Schedule for review and approval by the Owners Representatives.
 - 1. Submittal shall be an Exported PDF of the completed Excel Workbook.
 - a. As an Exported PDF the individual worksheets will be bookmarked and the document will be word searchable for easy reference.
- C. The GC shall only use the rates posted in the approved submittal throughout the execution of this contract.

3.03 EXAMPLE WAGE RATE FORM

Project Name:

Project Location:

Project Number:

Contractor:

Rates are based on the following documentation:

Enter TRADE Here:

Carpenter

Classification:

	Foreman	Journeyman	Laborer	Apprt 1	Other	Other	Other
Base Rate (BR)	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Vacation	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Health Insurance	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Pension	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Apprenticeship	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Sub-total	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
BR Sub-total	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Work. Comp	% of BR	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Gen Liability	% of BR	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
WI Unemploy	% of BR	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Fed Unemploy	% of BR	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
FICA	% of BR	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Sub-total		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
TOTAL COST		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00

Enter YOUR percentage of base rate in the column below.

% of BR

0

0

0

0.6

7.65

- Work. Comp

- Gen Liability

- WI Unemploy

- Fed Unemploy

- FICA

Form Instructions:

1. Provide a work sheet for ALL Trade Classifications that will be performing on site productive labor during the execution of this project.

2. Responsible contractor to complete only boxes that are shaded, all non-shaded boxes are formula driven.

3. Contractor shall provide the name of the source used for these rates. (union contract, Bureau of Labor and Statistics, AISC, ABC, etc.) and be prepared to provide copies if so requested.

END OF SECTION

**SECTION 00 62 76.13
SALES TAX FORM**

PART 1 – GENERAL

1.01 SUMMARY

- A. The City of Madison is a qualifying tax exempt entity in the State of Wisconsin.
- B. The Contractor shall refer to Section 102.9 – Bidders Understanding of the City of Madison FACILITIES MANAGEMENT SPECIFICATIONS for Public Works Construction for more information on Tax Exempt Status.
- C. This project constructs or remodels facilities owned by the City of Madison in Madison, Wisconsin.

1.02 RELATED SPECIFICATION SECTIONS

- A. Parts of this specification will reference articles within “The City of Madison FACILITIES MANAGEMENT SPECIFICATIONS for Public Works Construction”.
 - 1. Use the following link to access the FACILITIES MANAGEMENT SPECIFICATIONS web page:
<http://www.cityofmadison.com/business/pw/specs.cfm>
 - a. Click on the “Part” chapter identified in the specification text. For example if the specification says “Refer to City of Madison FACILITIES MANAGEMENT SPECIFICATION 210.2” click the link for Part II, the Part II PDF will open.
 - b. Scroll through the index of Part II for specification 210.2 and click the text link which will take you to the referenced text.

1.03 TAX EXEMPT FORM

- A. The Contractor can access Wisconsin Sales and Use Tax Exemption Certificates (form S-211, Wisconsin Department of Revenue) from the City of Madison Finance website.
 - 1. City of Madison tax exempt information and signature by Purchasing Supervisor is already completed.
 - 2. Website: <http://www.cityofmadison.com/employeenet/finance/purchasing>
 - a. Under the title Purchasing Forms, scroll down to the form link titled Sales Tax Exempt Form S-211.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 – EXECUTION – THIS SECTION NOT USED

END OF SECTION

SECTION 00 71 01
LIST OF COMMON ABBREVIATIONS

PART 1 GENERAL

1.01 ABBREVIATIONS AND ACRONYMS

- A. Every effort has been made to provide the definition of an abbreviation or acronym within the body of the specification section. However, some abbreviations or acronyms are common across multiple sections and are listed below. This is not an all inclusive list, so if an abbreviation or acronym is found that does not have a definition, please contact the Architect for clarification.

CoM	City of Madison
ABC	Associated Builders and Contractors
AGC	Associated General Contractors
BPW	City of Madison Board of Public Works
DCR	City of Madison Department of Civil Rights
MGO	Madison General Ordinance
PW	City of Madison Department of Public Works
<hr/>	
A/E PROJ MGR	Project Architect / Project Engineer
ACC	Autodesk Construction Cloud
BVC	Best Value Contracting
CB	Construction Bulletin
CCM	City Construction Manager
CO	Change Order
COR	Change Order Request
CPM	City Project Manager
CxA	Commissioning Agent
GC	General Contractor
GCPM	General Contractor Project Manager
PA	Project Architect
PLS	Principal Land Surveyor
PM	Project Manager
PMWS	Project Management Website
PP	Progress Payment
PPA	Progress Payment Applications
QMO	Quality Management Observation
RFI	Request for Information
SBE	Small Business Enterprise
SOV	Schedule of Values

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 23 00
ALTERNATES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Description of Alternates.

1.02 RELATED REQUIREMENTS

- A. Document 08 80 00 - Glazing: Glazing alternate types.

1.03 ACCEPTANCE OF ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.04 SCHEDULE OF ALTERNATES

- A. Alternate No. 1: GLAZING
 - 1. Base Bid Item: Section 08 80 00 - Glazing and Drawing number A810 and A811.
 - a. Glass Type IG-1B within Frame Types SF-19 and SF-21.
 - 2. Alternate Item: Section 08 80 00 - Glazing and Drawing number A810 and A811.
 - a. Provide Add alternate pricing for Glass Type IG-3B within Frame Types SF-19 and SF-21.
- B. Alternate No. 2: GLAZING
 - 1. Base Bid Item: Section 08 80 00 - Glazing and Drawing number A810 and A811.
 - a. Glass Type IG-1B and IG-2B within Frame Types SF-18.
 - b. Glass Type IG-1B within Frame Types SF-19, SF-20 and SF-21.
 - 2. Alternate Item: Section 08 80 00 - Glazing and Drawing number A810 and A811.
 - a. Provide Add alternate pricing for Glass Type IG-3B within Frame Types SF-18, SF-19, SF-20 and SF-21.

PART 2 PRODUCTS - NOT USED**PART 3 EXECUTION - NOT USED****END OF SECTION**

SECTION 01 25 13
PRODUCT SUBSTITUTION PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

- A. The City of Madison uses a specific list of preferred products for various specification items to establish standards of quality, utility, and appearance required.
- B. The City of Madison will not allow substitutions for specified Products except as follows:
 - 1. The Product is no longer produced or the product manufacturer is no longer in business.
 - 2. The manufacturer has significantly changed performance data, product dimensions, or other such design criteria for the specified Product(s).
 - 3. Products specified by naming one or more Products or manufacturer's and "or approved equal" or "approved equivalent."
- C. The City of Madison will not allow substitutions for specified Products as follows:
 - 1. For Products specified by naming only one Product and manufacturer, no substitute product will be considered.
 - 2. For Products specified by naming several Products or manufacturers select any one of the products or manufacturers named, which complies with the specifications. No substitute product will be considered.
- D. Request for substitutions from any party other than the General Contractor (GC) will not be accepted.

1.02 RELATED SPECIFICATIONS

- A. Section 00 43 25 - Request Form (During Bidding).
- B. Section 01 26 13 - Request for Information (RFI).
- C. Section 01 31 23 - Project Management Web Site.
- D. Section 01 33 23 - Submittals.

PART 2 – PRODUCTS

2.01 SUBSTITUTION REQUEST FORM

- A. During bidding all contractors (General and Sub-contractors) and suppliers of materials or products shall reference Specification Section 00 43 25 and provide a pdf copy of the Substitution Request form located at the end of that section with all required attachments directly to the Project Architect.
- B. After bidding only the GC shall submit a request and shall use the form located at the end of this specification and submit the request on the Project Management Web Site.

PART 3 - EXECUTION

3.01 REQUESTING A SUBSTITUTION DURING BIDDING

- A. In the event that a substitution is requested during the bidding phase the Contractor or Supplier shall meet the substitution request deadline listed in the bidding documents. No substitution request will be considered during the bidding period after the stated substitution request deadline.
- B. See specification 00 43 25 - Substitution Request Form (During Bidding).

3.02 REQUESTING A SUBSTITUTION AFTER AWARD OF CONTRACT

- A. A substitution request will only be considered after award of contract if it meets the qualifying provisions as described in 1.01.B.1 and .2 above.
- B. The GC shall submit a substitution request using the digital form on the Project Management Web Site.
 - 1. Consulting Staff, Owner and Owners Representatives will review the request and provide the appropriate approvals and feed back to the GC.

3.03 UNAUTHORIZED SUBSTITUTIONS

- A. Any Contractor who substitutes products without proper authorization by the Owner and Architect will be required to immediately remove and replace the product and all costs required to conform to the Contract Documents shall be borne by the General Prime Contractor.

3.04 SAMPLE SUBSTITUTION REQUEST FORM

For Pre-bid Substitution Requests all text boxes on this form are required information for a complete request.

	<h2 style="margin: 0;">Substitution Request</h2>
Today's Date: <input style="width: 100px;" type="text"/>	
Project Title: <input style="width: 400px;" type="text"/>	
Project Number: <input style="width: 100px;" type="text"/> Contract Number: <input style="width: 100px;" type="text"/>	
<p><i>By completing and submitting this form for review the General Contractor affirms that all of the following statements are correct:</i></p> <ol style="list-style-type: none"> 1 The General Contractor affirms that this request is in compliance with the requirements described in <i>Specification 01 25 13 Product Substitution Procedures</i>. 2 The function, appearance, and quality of the proposed substitution are equal or superior to the specified item. 3 The proposed substitution does not affect dimensions shown on the drawings. 4 The proposed substitution will have no adverse affects on other trades, the construction schedule, or any specified warranty requirements. 5 Maintenance and service parts will be locally available for the proposed substitution. (GC shall provide supporting documentation in the attachments section below.) 6 The General Contractor shall be responsible for any and all costs associated with this substitution request if approved. This includes but is not limited to fees for building design, engineering design fees, detailing fees, plan review fees, construction costs, and inspection fees. 	
GC Substitution Request:	
General Title: <input style="width: 300px;" type="text"/>	
Related Specification: <input style="width: 30px;" type="text"/> <input style="width: 30px;" type="text"/> <input style="width: 30px;" type="text"/>	
Reason for Substitution: <input style="width: 300px;" type="text"/>	
Proposed Substitution: <small>(include Name, Model, etc.)</small> <input style="width: 300px;" type="text"/>	
Submitted By: <input style="width: 150px;" type="text"/>	Phone: <input style="width: 100px;" type="text"/>
Company: <input style="width: 150px;" type="text"/>	Email: <input style="width: 150px;" type="text"/>

END OF SECTION

SECTION 01 26 13
REQUEST FOR INFORMATION (RFI)

PART 1 – GENERAL

1.01 SUMMARY

- A. Contractors shall use the RFI form/process to request additional information or clarification regarding the construction documents.
- B. All RFI documentation will be processed through the through the Project Management Web Site.

1.02 RELATED SPECIFICATIONS

- A. Section 01 26 46 - Construction Bulletin (CB).
- B. Section 01 26 57 - Change Order Request (COR).
- C. Section 01 26 63 - Change Order (CO).
- D. Section 01 31 23 - Project Management Web Site.
- E. Section 01 91 00 - Commissioning.

1.03 PERFORMANCE REQUIREMENTS

- A. RFI issues initiated by any contractor shall be done through the General Contractor (GC).
 - 1. RFIs submitted by any Sub-contractor under the GCs control shall be returned with no response.
- B. Submit a new RFI for each issue. Only multiple questions that are of a similar nature may be combined into one RFI shall be allowed and responded to.

1.04 QUALITY ASSURANCE

- A. The GC shall be responsible for all of the following:
 - 1. Ensure that any request for additional information is valid and the information being requested is not addressed in the construction documents.
 - 2. Ensure that all requests are clearly stated and the RFI form is completely filled out.
 - 3. Ensure that all Work associated an RFI response is carried out as intended.
- B. The Project Architect /Project Engineer (A/E PROJ MGR) shall be responsible for the following:
 - 1. Ensure that all responses to contractor initiated RFIs are properly responded to in a timely fashion.
 - a. The CPM, Owner, consulting staff, and other City staff shall be responsible for the initial review of the RFI. The A/E PROJ MGR shall be responsible for codifying all consultant and Owner/City staff comments into a unified RFI response.

PART 2 – PRODUCTS

2.01 REQUEST FOR INFORMATION FORM

- A. The RFI form is located on the Project Management Web Site.

PART 3 - EXECUTION

3.01 CONTRACTOR INITIATED RFI

- A. Immediately on discovery of the need for additional information or interpretation of the Contract Documents any contractor may initiate an RFI for additional information or clarification through the GC.
- B. The GC shall use the Project Management Web Site and completely fill out the form.
 - 1. Thoroughly explain the issue at hand, provide backup information (photographs, sketches, drawings, data, etc.) as necessary, and clearly state the question or problem that requires a resolution. Combine like or related issues but do not include multiple issues on one form.
 - a. Example. If a duct interferes with other critical piping and electrical work include all issues into one RFI.

- b. Example. If you have a question regarding the chiller and another regarding toilet partitions create separate RFIs.

3.02 RFI RESPONSES

- A. Responses to simple RFI issues shall be completed within **five (5) working days** of the RFI form being submitted.
- B. Responses to more complex issues may require additional time or may require a Construction Bulletin to be published. The initial RFI shall be responded to within five (5) working days stating that the RFI is being reviewed and provide an estimated date for the response.
- C. The following GC generated RFIs will be returned without action:
 - 1. Requests for approval of submittals.
 - 2. Requests for approval of substitutions.
 - 3. Requests for approval of Contractor's means and methods.
 - 4. Requests for coordination information already indicated in the Contract Documents.
 - 5. Requests for adjustments in the Contract Time or the Contract Sum.
 - 6. Requests for interpretation of A/E's actions on submittals.
 - 7. Incomplete RFI or inaccurately prepared RFI.

3.03 COMMENCEMENT OF WORK RELATED TO AN RFI

- A. The GC shall only proceed with the Work of an RFI when additional information is not required.
- B. The GC shall not proceed with any Work associated with an RFI while it is under review.
- C. The GC shall not proceed with any Work associated with an RFI that clearly states a CB will be issued in response to the RFI.
- D. The GC will be required to immediately remove and replace unauthorized Work and all costs required to conform to the Contract Documents shall be borne by the GC.

END OF SECTION

**SECTION 01 26 46
CONSTRUCTION BULLETIN (CB)**

PART 1 – GENERAL

1.01 SUMMARY

- A. Construction Bulletins (CB) are formal published construction documents that modify the original contract bid documents after construction has commenced. CBs may be published for many reasons, including but not limited to the following:
 - 1. Clarification of existing construction documents including specifications, plans, and details.
 - 2. Change in product or equipment.
 - 3. A response to a Request for Information.
 - 4. Change in scope of the contract as either an add or a deduct of work.
- B. CBs provide a higher degree of detail in response to a Request for Information (RFI) through directives, revised plans/details, and specifications as necessary.
- C. The CB may change the original contract documents through additions or deletions to the Work.
- D. Where the directives of a CB are significant enough to warrant a Change Order Request (COR) the GC shall use all information provided in the CB to assemble all required back-up documentation for additions and deletions of materials, labor and other related contract costs for the COR.
- E. All CB documentation will be processed through the Project Management Web Site (PMWS).

1.02 RELATED SPECIFICATIONS

- A. Section 01 26 13 - Request for Information (RFI).
- B. Section 01 26 57 - Change Order Request (COR).
- C. Section 01 26 63 - Change Order (CO).
- D. Section 01 31 23 - Project Management Web Site.
- E. Section 01 91 00 - Commissioning.

1.03 PERFORMANCE REQUIREMENTS

- A. Project Architect /Project Engineer (A/E PROJ MGR): The A/E PROJ MGR shall be the only person authorized to publish a CB as needed for any reason indicated in section 1.1.A above. The A/E PROJ MGR shall consult as necessary with any of the following while drafting the CB and shall confirm final direction with the CPM prior to issuing a CB:
 - 1. City Project Manager (CPM).
 - 2. Owner.
 - 3. Members of the consulting staff.
 - 4. Members of city staff.
 - 5. The General Contractor (GC).
 - 6. Sub-contractors.
 - 7. Commissioning Agent (CxA).
- B. General Contractor: The GC shall be responsible for the following as needed:
 - 1. Executing the directives of the CB when they believes that no changes in labor, materials, equipment, or contract duration will be required for additions or deletions.
 - 2. Submit a COR when they believes that a change in labor, materials, equipment or contract duration will be required for additions or deletions.

1.04 QUALITY ASSURANCE

- A. The A/E PROJ MGR shall be responsible for ensuring the final CB sufficiently provides direction, details, specifications and other information as necessary for the GC to perform the intended Work.

- B. The A/E PROJ MGR shall be responsible for ensuring the final CB is published as expeditiously as practical based on the complexity of the CB being written. CBs that may affect the GC critical path shall be given priority.

PART 2 – PRODUCTS

2.01 CONSTRUCTION BULLETIN FORM

- A. The CB form is located on the Project Management Web Site.

PART 3 - EXECUTION

3.01 WRITING THE CONSTRUCTION BULLETIN

- A. The A/E PROJ MGR shall draft a CB as needed using the Construction Bulletin form on the Project Management Web Site.
 - 1. The A/E PROJ MGR and/or consulting staff as necessary shall provide specifications, model numbers and performance data, details and other such information necessary to clearly state the intentions of the CB.
 - 2. The consulting staff, CPM, Owner, CxA and other City Staff shall review the draft and recommend changes as needed.
 - 3. The A/E PROJ MGR shall amend the draft as necessary into a final CB for review.
 - 4. Full plan sheets and entire specification sections referred to within a CB, shall be reissued with the CB.
- B. Once the final CB has been approved the A/E PROJ MGR shall “Submit” the CB through the Project Management Web Site to the City Project Manager.
- C. The City Project Manager (CPM) will close and distribute the CB.

3.02 EXECUTING THE CONSTRUCTION BULLETIN

- A. The GC shall acknowledge receipt of the CB on the Project Management Web Site (PMWS) as instructed in the Tutorial Manual provided to the awarded contractor.
- B. The GC shall notify all Sub-contractors of the CB and publish the CB to all field sets of drawings and specifications as appropriate.
- C. The GC shall execute the directives of the CB or submit COR documentation as necessary during the execution and implementation of the CB.
 - 1. See Specification 01 26 57 - Change Order Request (COR).

END OF SECTION

SECTION 01 26 57
CHANGE ORDER REQUESTS (COR)

PART 1 – GENERAL

1.01 SUMMARY

- A. Except in cases of emergency, no changes in the Work required by the Contract Documents may be made by the General Contractor (GC) without having prior approval of the City Engineer or their representative.
- B. The City may at any time, without invalidating the Contract and without Notice to Sureties, order changes in the Work by written Change Order (CO). Such changes may include additions and/or deletions.
- C. Where the City desires to make changes in the Work through use of written Change Order Request (COR), the following procedures apply:
 - 1. If requested by the City, the GC shall prepare and submit a detailed proposal, including all cost and time adjustments to which the GC believes it will be entitled if the change proposed is incorporated into the Contract. The City shall be under no legal obligation to issue a Change Order for such proposal.
 - 2. The parties shall attempt in good faith to reach agreement on the adjustments needed to the Contract to properly incorporate the proposed change(s) into the Work. In the event that the parties agree on such adjustments, the City may issue a Change Order (CO) and incorporate such changes and agreed adjustments, if any.
 - 3. In some instances, it may be necessary for the City to authorize Work or direct changes in Work for which no final and binding agreement has been reached and for which unit prices are not applicable. In such cases the following shall apply.
 - a. Upon written request by the City, the GC shall perform proposed Work.
 - b. The cost of such change may be determined in accordance with this specification.
 - c. In the event agreement cannot be accomplished as contemplated herein, the City may authorize the Work to be performed by City forces or to hire others to complete the Work. Such action on the part of the City shall not be the basis of a claim by the GC for failure to allow it to perform the changed Work.
- D. Where changes in the Work are made by the City through use of a force account basis, the GC shall as soon as practicable, and in no case later than ten (10) working days from the receipt of such order, unless another time period has been agreed to by both parties, give the City written Notice, stating:
 - 1. The date, circumstances and source of the extra work; and,
 - 2. The cost of performing extra work described by such Order, if any; and,
 - 3. Effect of the order on the required completion date of the Project, if any.
- E. The giving of each Notice by the GC as prescribed by this specification, shall be a requirement to liability of the City for payment of any additional costs incurred by the GC in implementing changes in the Work. Under this specification, no order or statement of the City shall be treated as a Change Order, or shall entitle the GC to an equitable adjustment of the terms of this Contract or damages for costs incurred by the GC on any activity for which the Notice was not given.
- F. In the event Work is required due to an emergency as described in this specification the GC must request an equitable adjustment as soon as practicable, and **in no case later than ten (10) working days** of the commencement of such emergency.
- G. All GC requests for equitable adjustment shall be submitted to the CPM per the specifications below. Such requests shall set forth with specificity the amount of and reason(s) for the proposed adjustment and shall be accompanied by supporting information and documents.
- H. No adjustment of any kind shall be made to this Contract, if asserted by the GC for the first time, after the date of final payment.

- I. This specification shall be used by the GC when preparing documentation for any COR to ensure each has been properly and completely filled out as required by the City of Madison.
- J. All COR documentation will be processed through the Project Management Web Site.

1.02 RELATED SPECIFICATION SECTIONS

- A. Section 01 26 13 - Request for Information (RFI).
- B. Section 01 26 46 - Construction Bulletins (CB).
- C. Section 01 26 63 - Change Order (CO).
- D. Section 01 31 23 - Project Management Web Site.
- E. Section 01 91 00 - Commissioning.
- F. Parts of this specification will reference articles within "The City of Madison FACILITIES MANAGEMENT SPECIFICATIONS for Public Works Construction".
 - 1. Use the following link to access the FACILITIES MANAGEMENT SPECIFICATIONS web page:
<http://www.cityofmadison.com/business/pw/specs.cfm>
 - a. Click on the "Part" chapter identified in the specification text. For example if the specification says "Refer to City of Madison FACILITIES MANAGEMENT SPECIFICATION 210.2" click the link for Part II, the Part II PDF will open.
 - b. Scroll through the index of Part II for specification 210.2 and click the text link which will take you to the referenced text.

1.03 DEFINITIONS AND STANDARDS

- A. LABOR: The amount of time and cost associated with the performance of human effort for a defined scope of Work. Labor is further defined as follows:
 - 1. Labor rate is the total hourly rate which includes the basic rate of pay, fringe benefits plus each company's cost of required insurance, also referred to as a reimbursable labor rate.
 - 2. Unit labor is the labor hours anticipated to install the corresponding unit of material.
 - 3. Labor cost is the labor hours multiplied by the hourly labor rates.
- B. MATERIAL: Actual material cost is the amount paid, or to be paid, by the GC for materials, supplies and equipment entering permanently into the Work, including cost of transportation and applicable taxes. The cost shall not exceed the usual and customary cost for such items available in the geographical area of the project
- C. LARGE TOOLS AND MAJOR EQUIPMENT: Large tools and major equipment are those with an initial cost greater than \$1,500, whether from the GC or other sources.
 - 1. Tool and equipment use and time allowed is only for extra work associated with change orders.
 - a. Rental Rate is the machine cost associated with operating a piece of equipment for a defined length of time (hour, day, week, or month) and shall not exceed the usual and customary amount for such items available in the geographical area of the project.
 - b. Rental cost is the rental rate multiplied by the anticipated duration the equipment shall be required.
 - 2. The GC shall provide a breakdown of all rental rates to indicate what items and costs are associated with the rate. Examples of items to include in the breakdown would be fuel consumption, lubrication, maintenance and other similar expenses but not including profit and overhead.
 - 3. When large tools and equipment needed for Change Order work are not already at the job site, the actual cost to get the item there is also reimbursable.
- D. BOND COST: The cost shall be calculated at 1% of the total proposed change order.
- E. SUB-CONTRACTOR COSTS: Sub-contractor costs are for those labor, material, and equipment costs required by subcontracted specialties to complete the Change Order work.

- F. **OVERHEAD AND PROFIT Markup:** The allowable markup percentage to a COR by the GC and Sub-contractors for overhead and profit. All of the following are expenses associated with overhead and profit and shall not be reimbursable as individual items on any COR:
1. **CHANGE ORDER PREPARATION:** All costs associated with the preparing and processing of the change order.
 2. **DESIGN, ESTIMATING, AND SUPERVISION:** All such efforts, unless specifically requested by Owner as additional Work to be documented as a COR or portion thereof.
 3. **INSTALLATION LAYOUT:** The layout required for the installation of material and equipment, and the installation design, is the responsibility of the GC.
 4. **SMALL TOOLS AND SUPPLIES:** The cost of small hand tools with an initial cost of \$1,500 or less, along with consumable supplies and expendable items such as drill bits, saw blades, gasoline, lubricating or cutting oil, and similar items.
 5. **GENERAL EXPENSE:** The general expense, which is those items that are a specific job cost not associated with direct labor and material such as job trailers, foreman truck, and similar items.
 6. **RECORD DRAWINGS:** The preparation of record or as-built drawings.
 7. **OTHER COSTS:** Any miscellaneous cost not directly assessable to the execution of the Change Order including but not limited to the following:
 - a. All association dues, assessments, and similar items.
 - b. All education, training, and similar items.
 - c. All drafting and/or engineering, unless specifically requested by Owner as additional Work to be documented as a Change Order proposal or portion thereof.
 - d. All other items including but not limited to review, coordination, estimating and expediting, field and office supervision, administrative work, etc.
- G. **Contract Extension:** The necessary amount of time to be added to the contract deadlines for the completion of a change order.

1.04 CONTRACT EXTENSION

- A. The GC shall not assume that every COR will require a Contract Extension. If the GC feels a contract extension is warranted, they shall provide sufficient scheduling information that shows how the COR being requested impacts the critical path of the project.
- B. The City of Madison strongly encourages the GC to explore alternative methods and practices prior to submitting a COR with a request for contract extension.

1.05 OVERHEAD AND PROFIT MARKUP

- A. Pursuant to the City of Madison FACILITIES MANAGEMENT SPECIFICATIONS for Public Works Construction, Section 104.7, Extra Work, the following maximum allowable markups shall be strictly enforced on all change orders associated with the execution of this contract.
1. The total maximum overhead and profit shall not exceed fifteen percent (15%) of the total costs.
 2. The total maximum overhead and profit shall be distributed as follows:
 - a. For work performed and materials provided solely by the General Contractor, fifteen percent (15%) of the total costs.
 - b. For work performed and materials provided solely by Sub-contractors and supervised by the General Contractor:
 - 1) Supervision of the GC, five percent (5%) of the total Sub-contractor cost.
 - 2) Sub-contractors work and materials ten percent (10%) of the total Sub-contractor cost.

1.06 PERFORMANCE REQUIREMENTS

- A. The GC shall become thoroughly familiar with this specification as it will identify procedures and expenses that are or are not allowed under the Change Order and Change Order Request process.
- B. The GC shall be responsible for all of the following:
1. Carefully reviewing the CB that is associated with the COR.

2. Collecting required supporting documentation from all contractors that quantify the need for a COR.
 - a. Labor hours and wage rates
 - b. Material costs
 - c. Equipment costs
- C. The following shall apply to establishing prices for labor, materials, and equipment costs:
 1. Where Work to be completed has previously been established by individual bid items in the contract bid proposal the GC shall use the unit bid prices previously established.
 2. Where Work to be completed was bid as a Lump Sum without individual bid items the GC shall provide a breakdown of all labor, materials, equipment including unit rates and quantities required.
- D. The completion date is determined by Owner. The schedule, however, is the responsibility of the GC. Time extensions for extra Work will be considered when a schedule analysis of the critical path shows that the Change Order Request places the Work beyond the completion date stated in the Contract.

1.07 QUALITY ASSURANCE

- A. The GC shall be responsible for ensuring that all COR supporting documentation meets the following requirements prior to completing the COR form on the Project Management Web Site:
 1. Sufficiently indicates labor, material, and other expenses related to completing the intent of the CB.
 2. No costs exceed the usual and customary amount for such items available in the geographical area of the project, and no costs exceed those established under the contract.
- B. The Project Architect /Project Engineer /A/E PROJ MGR, Commissioning Agent (CxA), City Project Manager (CPM), other members of the consulting staff, and city staff shall review all COR requests to ensure that the intent of the CB will be met under the proposal of the COR or request additional information as necessary.

PART 2 – PRODUCTS

2.01 CHANGE ORDER REQUEST FORM

- A. The COR form is located on the Project Management Web Site.

PART 3 - EXECUTION

3.01 ESTABLISHING A CHANGE ORDER REQUEST

- A. Upon receipt of a Construction Bulletin (CB) where the GC believes a significant change in contract scope warrants the submittal of a COR the GC shall do all of the following within ten (10) working days after receipt of the CB:
 1. Review the CB with all necessary trades and sub-contractors required by the change in scope.
 - a. Additions or deletions to the contract scope shall be as directed within the CB.
 - b. Additions or deletions of labor and materials shall be determined by the GC based on the directives of the CB.
 2. Assemble all required back-up documentation for additions and deletions of materials, labor and other related contract costs as previously outlined in this specification.
 3. Submit a COR request form on the Project Management Web Site.
- B. Submitting a COR does not obligate the GC to complete the work associated with the COR nor does it obligate the Owner to approve the COR as a change to the contract.

3.02 SUBMIT A CHANGE ORDER REQUEST FORM

- A. This specification shall provide a subject overview only. In depth instructions shall be provided to the awarded Contractor in a PDF Instructional Manual.
- B. The GC shall select the appropriate link on the Project Management Web Site.

- C. The software will open a new COR form and the GC shall provide all of the following information:
 - 1. DO NOT perform any calculations on this worksheet, only provide the raw data as requested below. All calculations, totals, and markups shall be computed as described within this specification.
 - 2. Provide a summary description of the COR request, and justification for any requested time extension to the contract, indicate the number of calendar days being requested for the extension and add any attachments to the form as needed.
 - 3. Provide all GC self-performance data including all of the following:
 - a. Materials description, quantities, and unit costs.
 - b. Labor hours and rates for all Foremen, Journeymen, and Apprentices by trade.
 - c. Equipment descriptions, quantities, unit costs and rates.
 - 4. Provide all Sub-contractor data including all of the following:
 - a. Materials description, quantities, and unit costs.
 - b. Labor hours and rates for all Foremen, Journeymen, and Apprentices by trade.
 - c. Equipment descriptions, quantities, unit costs and rates.
 - 5. Ensure all calculations performed by the form have been completed correctly. Contact the CPM directly if you suspect an error before hitting the save button.
- D. When all data has been entered submit the COR form. This will kick off the COR Review and Approval process.

3.03 CHANGE ORDER REQUEST REVIEW, APPROVAL, AND PROCESSING

- A. The A/E PROJ MGR and CPM shall review all CORs submitted by the GC.
 - 1. Additional consulting staff and city staff having knowledge of the components of the COR shall review and advise the A/E PROJ MGR and CPM as to the accuracy of the items, quantities, and associated costs of the COR as directed by the CB.
 - 2. The CPM shall review the COR with the Owner.
- B. If required the A/E PROJ MGR and CPM, shall in good faith, further negotiate the COR with the GC as necessary. All amendments to any COR shall be documented within the Project Management Web Site software.
- C. After final review of the COR the CPM and Owner may accept the COR.
- D. The CPM shall prepare the COR in the form of an official Board of Public Works Change Order for final review and approval as outlined in Section 01 26 63 - Change Order (CO).
- E. The GC shall not act upon any accepted COR until it has received final approval through the Public Works process as an official CO to the Work unless instructed to do so by the CPM. Proceeding without the final approval of a fully authorized Change Order is at the GC's own risk.

3.04 EMERGENCY CHANGE ORDER REQUEST

- A. In the event Work is required due to an emergency as described in the Contract Documents, the GC must request an equitable adjustment as soon as practicable, and in no case later than ten (10) working days of the commencement of such emergency.
- B. The GC shall provide full documentation of all labor, materials and equipment used during the period of emergency as part of the COR submittal.

END OF SECTION

**SECTION 01 26 63
CHANGE ORDER (CO)**

PART 1 – GENERAL

1.01 SUMMARY

- A. Except in cases of emergency, no changes in the Work required by the Contract Documents may be made by the General Contractor (GC) without having prior approval of the City Project Manager (CPM).
- B. The City may at any time, without invalidating the Contract and without Notice to Sureties, order changes in the Work by written Change Order. Such changes may include additions and/or deletions.
- C. The Change Order (CO) is a Board of Public Works (BPW) form that is reviewed and approved by a specific process.
- D. The CO form is typically made up of multiple Change Order Requests (CORs) and/or Bid Items as appropriate depending on the type of project and how the contract was bid.
- E. All CO documentation shall be processed through the Project Management Web Site.

1.02 RELATED SPECIFICATION SECTIONS

- A. Section 01 26 13 - Request for Information (RFI).
- B. Section 01 26 46 - Construction Bulletin (CB).
- C. Section 01 26 63 - Change Order Request (COR).
- D. Section 01 31 23 - Project Management Web Site.
- E. Section 01 91 00 - Commissioning.

1.03 BOARD OF PUBLIC WORKS PROCEDURE

- A. The Board of Public Works has a very explicit procedure for the review and approval of all change orders associated with any Public Works Contract as follows:
 - 1. The Supervisory Chain of the CPM shall review and approve any CO under \$20,000 provided it does not include either of the following:
 - a. The CO does not request a time extension to the contract.
 - b. The CO does not cause the contract contingency sum to be exceeded.
 - 2. The Board of Public Works shall review and approve any CO that requires any of the following:
 - a. Any CO over \$20,000.
 - b. Any CO requesting a time extension to the contract regardless of the monetary value of the CO.
 - c. Any CO that causes the contract contingency sum to be exceeded.
- B. The Board of Public Works generally meets every other week and only once in August and December. The GC is cautioned that, under normal scheduling, a CO requiring a BPW review will take a minimum of two (2) weeks to achieve final approval.
 - 1. The City shall not be responsible for additional delays to the Work caused by the scheduling constraints of the Board of Public Works.
- C. SPECIAL NOTE: The GC is cautioned to never proceed unless told to do so by the CPM. Only in rare instances may the CPM give a written notice to proceed on a COR without an approved CO. Proceeding without the written notice of the CPM or an approved CO is at the GC's own risk.

PART 2 – PRODUCTS

2.01 CHANGE ORDER FORM

- A. The CO form is located on the Project Management Web Site. The CPM shall click the link in the left margin of the project web site opening a new form. Project information is pre-loaded, the CPM only needs to enter information and make attachments as needed to complete the form.

PART 3 - EXECUTION**3.01 PREPARATION OF THE CHANGE ORDER**

- A. The CPM shall prepare the required CO forms in the Project Management Web Site as follows:
 - 1. Provide information for all contract information.
 - 2. Provide a general description of the items described within the change order.
 - 3. Provide detailed information for each Item on the CO form. At the option of the CPM, they may include multiple Change Order Requests each as their own item.
 - 4. Provide required pricing and accounting information as needed for the item.
 - 5. Insert attachments of contractor/architect provided information that clarifies and quantifies the CO. Attachments may include but not be limited to material lists, estimated labor, revised details or specifications, and other documents that may be related to the requested change.
 - 6. Save the final version of the completed CO.

3.02 EXECUTION OF THE CHANGE ORDER

- A. Upon saving the CO as described in section 3.1 above, the software associated with the Project Management Web Site shall notify the GC that the CO has been drafted and is ready for review. The GC shall do the following:
 - 1. Open the CO form using the link provided in the email notification and review all items on the form.
 - 2. The GC shall notify the CPM immediately of any errors or discrepancies on the form and shall not sign or save it.
 - a. The CPM shall make any corrections as needed, re-save the form, and notify the GC.
 - 3. If/when the GC concurs with the CO form as drafted the GC shall digitally sign the form and click SAVE.
- B. After the GC digitally signs/saves the CO it shall be routed through the Project Management Web Site for additional review and/or approvals. The CPM shall do the following:
 - 1. Monitor the review process to ensure the software is working properly at each review step.
 - 2. Ensure that proper BPW procedures are executed as needed by the CO approval process.
 - a. Schedule the CO on the next available BPW agenda if required.
 - 1) Attend the BPW meeting to speak on the CO to board members and answer questions.
 - 2) The GC and/or the Project Architect /Project Engineer (A/E PROJ MGR) may be required to attend the BPW meeting to address specific information as it relates to the Work and/or materials associated with the CO.
 - 3. Monitor final approval and distribution of the CO.
 - 4. Notify the GC that the CO has been completed.
 - 5. Ensure that the CO is posted to the next Public Works payment schedule.
 - 6. Verify that the GC's next Progress Payment-Schedule of Values show the CO as part of the contract sum.
- C. Upon final approval of the CO the GC may proceed with executing the Work associated with the CO.

END OF SECTION

SECTION 01 29 73 SCHEDULE OF VALUES

PART 1 – GENERAL

1.01 SUMMARY

- A. The Schedule of Values (SOV) is a Contractor provided statement that allocates portions of the total contract sum to various portions of the contracted work and shall be the basis for reviewing the Contractors Progress Payment Requests.
- B. B.
- C. The General Contractor shall be responsible for filling out and updating the SOV in the Project Management website with each Progress Payment Request.

1.02 RELATED SPECIFICATIONS

- A. Section 01 26 63 - Change Order (CO).
- B. Section 01 29 76 - Progress Payment Procedures.
- C. Section 01 31 23 - Project Management Web Site.
- D. Section 01 32 26 - Construction Progress Reporting.
- E. Section 01 33 23 - Submittals.
- F. Parts of this specification will reference articles within "The City of Madison FACILITIES MANAGEMENT SPECIFICATIONS for Public Works Construction".
 - 1. Use the following link to access the FACILITIES MANAGEMENT SPECIFICATIONS web page:
<http://www.cityofmadison.com/business/pw/specs.cfm>
 - a. Click on the "Part" chapter identified in the specification text. For example, if the specification says "Refer to City of Madison FACILITIES MANAGEMENT SPECIFICATION 210.2" click the link for Part II, the Part II PDF will open.
 - b. Scroll through the index of Part II for specification 210.2 and click the text link which will take you to the referenced text.

1.03 RELATED DOCUMENTS

- A. The following documents shall be used as the basis for initiating and maintaining the SOV worksheets throughout the execution of this contract.
 - 1. Drawing documents and specifications (including general provisions) as provided with the bid set documents and any published addendums.
 - 2. Documents associated with revisions or clarifications to number 1 above after awarding of the contract, including but not limited to:
 - a. Construction Bulletins.
 - b. Request for Information.
 - 1) Approved Change Orders.
 - 3. The latest daily/weekly Construction Progress Report.
 - 4. Other specifications as identified in Section 1.02 above.

1.04 BASIS OF VALUES

- A. The Contractor shall provide a breakdown of the Contract Sum in sufficient detail to assist the Architect and City Project Manager in evaluating Progress Payment Requests. The breakdown detail may require a labor and material breakdown for each division of work or trade or as directed by the CPM.
- B. The total sum of all items shall equal the Contract Sum.

PART 2 – PRODUCTS – THIS SECTION NOT USED**PART 3 - EXECUTION****3.01 APPLICATION FOR PAYMENT**

- A. The Contractor shall use the Project Management website or Payment with each Progress Payment Request.
- B. Completely fill out the Pay Application per the tutorial provided for the PMWS
 - 1. Fill out to reflect the current status of the contract through the payment date being requested.
 - 2. The City of Madison calculates retainage on Public Works Contracts as follows:
 - a. In general, across the duration of the contract, 2.5% of the total contract sum, including change orders, is withheld for retainage as referenced from the City of Madison FACILITIES MANAGEMENT SPECIFICATION 110.2:
 - 1) Beginning with Progress Payment 1, 5% retainage will be withheld until such time that 50% of the total contract sum has been paid out.
 - 2) No additional retainage will be withheld after 50% of the total contract sum has been paid, unless additional change orders have been approved after the 50% milestone has been reached. Per City of Madison FACILITIES MANAGEMENT SPECIFICATION 110.2, additional retainage up to 10%, may be held in the event there are holds placed by Affirmative Action or liquidated damages by BPW.
 - 3) Retainage for additional change orders after the 50% milestone will be withheld at the rate of 2.5% of the total cost of the change order.
 - 4) Retainage is based on the change orders posted to the City's contract worksheet at the time the progress payment is processed.
- C. Only change orders that have been finalized and posted to the City of Madison's Application for Partial Payment worksheet may be itemized into the SOV documents.
- D. The Contractor shall sign and date the application.

3.02 PROJECT MANAGEMENT WEBSITE SOV SPREADSHEET

- A. The Contractor shall use the PMWS spreadsheet provided by the City to itemize their SOV for this contract. Provide additional sheets as necessary.
- B. Provide information by any method that allocates portions of the total contract sum to various portions of the contracted work. Possible methods include combinations of the following:
 - 1. By division of work.
 - 2. By contractor, sub-contractor, sub sub-contractor.
 - 3. By specialty item or group.
 - 4. Other methods of breakdown as may be requested by the City Project Manager or City Construction Manager at the pre-construction meeting.
- C. Provide total cost of the item/description of work including proportionate shares of profit and overhead related to the item.

3.03 INITIAL SCHEDULE OF VALUES SUBMITTAL

- A. The Contractor shall upload their initial SOV to the Project Management Web Site, no later than five (5) working days after the Pre-construction Meeting.
 - 1. The level of detail shall be as described in section 3.02 above.
- B. The Project Architect /Project Engineer (A/E PROJ MGR) and the City Project Manager (CPM) shall review the SOV as any other submittal and may require modifications to reflect additional detail as necessary.
- C. The Contractor shall resubmit the SOV as necessary until such time as the A/E PROJ MGR and CPM have sufficient detail for assessing and approving future Progress Payment Applications.

- D. Progress Payment Application 1 will not be processed until such time as the Contractor has met this requirement regardless of the amount of work completed per the application.

3.04 SOV FOR PROGRESS PAYMENT REQUESTS

- A. The Contractor shall update the initial SOV with each Progress Payment Application as follows:
1. Initial items and values as part of Section 3.03 above will not be adjusted once the original Schedule of Values submittal has been approved.
 2. Change orders shall be added as additional items and values at the bottom of the SOV as they become approved and posted to the City's contract worksheet. The value for each change order shall be the value indicated on the SOV and shall stand alone. Values shall not be split out or combined with other existing items with similar work descriptions on the original SOV.
 3. Fill out columns to properly reflect the work completed and materials received since the last Progress Payment Application.
 4. Only materials delivered and stored on the project site may be reflected on SOV progress updates.
- B. Provide an updated project schedule with each Progress Payment application.
- C. See Specification 01 29 76 - Progress Payment Procedures for additional information on submitting Progress Payment Applications.

END OF SECTION

SECTION 01 29 76
PROGRESS PAYMENT PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

- A. The General Contractor (GC) shall review this and all related specifications prior to submitting progress payment requests.
- B. Progress payment requests (Partial Payment-PP) for this contract shall be applied for by the GC in the Project Management Web Site.
- C. The City Project Manager (CPM) shall review and amend or approve the PP on the Project Management Web Site.
- D. After approval of the PP by the CPM, they shall forward the PP to the appropriate agencies for BPW contractual review and payment processing.

1.02 RELATED SPECIFICATIONS

- A. Section 01 26 63 - Change Order (CO).
- B. Section 01 29 73 - Schedule of Values.
- C. Section 01 31 19 - Progress Meetings.
- D. Section 01 31 23 - Project Management Web Site.
- E. Section 01 32 16 - Construction Progress Schedules.
- F. Section 01 32 26 - Construction Progress Reporting.
- G. Section 01 33 23 - Submittals.
- H. Section 01 45 16 - Field Quality Control Procedures.
- I. Section 01 77 00 - Closeout Procedures.
- J. Section 01 78 13 - Completion and Correction List.
- K. Section 01 78 23 - Operation and Maintenance Data.
- L. Section 01 78 36 - Warranties.
- M. Section 01 78 39 - As-Built Drawings.
- N. Section 01 78 43 - Spare Parts and Extra Materials.
- O. Section 01 79 00 - Demonstration and Training.

1.03 RELATED DOCUMENTS

- A. The following documents shall be used when evaluating PP requests.
 - 1. Daily and weekly construction progress reports filed since the last payment request.
 - 2. Contractors Schedule of Values as updated from the last payment request. See Specification 01 29 73 - Schedule of Values.
 - 3. Any document that may be required to be submitted for review and approval, as noted by the specifications listed in Section 1.02 above, or the Progress Payment Milestone Schedule in Section 1.04 below, to achieve a required bench mark of contract progression or contract requirement.

1.04 PROGRESS PAYMENT MILESTONES

- A. City Engineering-Facility Management has developed the Project Payment Milestone Schedule (Section 1.04 below) to assist the GC in providing required construction specific documentation and general contractual documentation in a timely manner.

- B. The Progress Payment Milestone Schedule is not an all inclusive list. Multiple agencies review progress payment requests and contract closeout requests. Missing, incomplete, or incorrect documentation for any agency may be a cause for not processing progress payments. It shall be the sole responsibility of the Contractor for providing documentation as required or requested to the appropriate agencies.
- C. The milestone schedule is based on the contract total sum and shall be valid for most contracts. Milestone submittals will be required with whatever progress payment hits the percentage of contract total indicated in the schedule.
- D. The CPM shall review the milestone schedule with each progress payment request and at their option may elect to hold processing the progress payment until such time as the contractor has met the requirements for providing construction specific documentation.
- E. It shall be the General Contractors responsibility to comply with all BPW Contract Administration requirements and related deadlines as outlined in the Award Letter, Award Checklist, and Start Work Letter.

See next page for Progress Payment Milestone Schedule table.

Progress Payment (PP) Milestone Schedule		
MILESTONE DESCRIPTION	DUE BEFORE	REMARKS
BPW Contract Administration Documentation <ul style="list-style-type: none"> Workforce profiles Best Value Contracting Documentation Sub-contractors prequalification approval & Affirmative Action plans Submittals Schedule Other as may be required 	PP-1, or start work as applicable	<ul style="list-style-type: none"> For GC and Sub-contractors before PP-1 regardless of scheduling Sub-contractors (if applicable), due 10 days before they may start work Sub-contractors (if applicable), due 10 days before they may start work Specification 01 32 19
Required Construction Submittals/Administrative Documents <ul style="list-style-type: none"> Contractors Project Directory Schedule of Values Waste Management Plan Closeout Requirement Checklist Warranty Checklist Time Lapse Construction Camera (camera installed and operational) Submission and Completion of all long-lead construction element submittals 	PP-1	References <ul style="list-style-type: none"> Specification 01 31 23 Specification 01 29 73 Specification 01 74 19 Specification 01 77 00 Specification 01 78 36 Specification 01 32 33 Various Specifications
Construction Progress Milestones <ul style="list-style-type: none"> Early submittals, per submittal schedule Detailed Contract Schedules 	PP-1	See specifications for specific requirements <ul style="list-style-type: none"> Specification 01 32 19, Examples: concrete mix, structural steel, products with long lead times See Specification 01 32 16
General Construction Progress Requirements are all up to date <ul style="list-style-type: none"> Progress Schedules Submittals/Re-submittals (ongoing) Schedule of Values Progress Reporting LEED Documentation Waste Management documentation QMOs are being addressed and closed Progress Cleaning As-Built Drawings 	Each future PP	Verified with each Progress Payment Request <ul style="list-style-type: none"> Specification 01 32 16 Specification 01 33 23 Specification 01 29 73 Specification 01 32 26 All specifications with LEED documentation requirements Specification 01 74 19 Specification 01 45 16 Specification 01 74 13 Specification 01 78 39
* All of the above are being updated on the Project Management Web Site as required		
BPW Contract Administration Documentation <ul style="list-style-type: none"> Weekly payroll reports Best Value Contracting Reports SBE Reports 	25% CT or PP 2	See 1.04.E above. <i>This progress payment will be withheld by BPW for any missing contractual documentation.</i>
Construction Progress Milestones <ul style="list-style-type: none"> Construction/Contract Closeout Meeting #1 Submittals/Re-submittals complete 	50% CT	<ul style="list-style-type: none"> Specification 01 31 19 Specification 01 33 23

Progress Payment (PP) Milestone Schedule		
MIILESTONE DESCRIPTION	DUE BEFORE	REMARKS
Operation and Maintenance (O & M) drafts	60% CT	<ul style="list-style-type: none"> Specification 01 78 23
Construction/Contract Closeout Meeting #2 <ul style="list-style-type: none"> Construction closeout checklist 	70% CT	<ul style="list-style-type: none"> Specification 01 31 19 Specification 01 77 00
BPW Contract Administration Documentation <ul style="list-style-type: none"> Request Finalization Review from BPW 	80% CT	This is a recommendation to the GC and is not a requirement of this PP. <ul style="list-style-type: none"> Specification 01 77 00
Construction Progress Milestones <ul style="list-style-type: none"> Operation and Maintenance (O & M) finals, accepted All major QMO issues resolved As-Built Drawings, Division Trades ready for GC review 	80% CT	<ul style="list-style-type: none"> Specification 01 78 23 Specification 01 45 16; Items that could prevent occupancy Specification 01 78 39
All of the following shall be completed for this PP: <ul style="list-style-type: none"> Regulatory Inspections completed All QMO reports closed Demonstration and Training completed Attic Stock completed Final Cleaning 	90% CT	Contractor to determine the proper order of completion: <ul style="list-style-type: none"> Governing ordinances and statutes Specification 01 45 16 Specification 01 79 00 Specification 01 78 43 Specification 01 74 13
Construction Closeout Procedures: <ul style="list-style-type: none"> Letter of Substantial Compliance sent to BI and DHS as needed Certificate of Occupancy issued As-Built Drawings, finals, accepted City Letter of Substantial Completion Warranty letters dated and issued 	100% CT	<ul style="list-style-type: none"> Specification 01 77 00 Generated/Signed by the Architect Building Inspection Specification 01 78 39 Signed by the City Engineer Specification 01 78 36
* Completion of this begins the one year warranty.		
BPW Contract Administration Documentation Contract Closeout Procedures <ul style="list-style-type: none"> Construction Closeout has been completed Contractor requests final payment of retainage upon receiving City Letter of Substantial Completion All BPW contractual requirements are verified 	Final	<ul style="list-style-type: none"> Specification 01 77 00 Contractor must provide any missing BPW Contractual Documentation
* Completion of this closes the contract but not the warranty period/bond.		
NOTE: CT = Contract Total less held retainage		

1.05 PROGRESS PAYMENT SUBMITTAL

- A. Each progress payment submittal shall be completed in the Project Management Website. See guide on the Project Management Website for the procedure.
- B. Submit all required construction progress documentation to the appropriate Project Management Web Site component as described in guides.
- C. In general the following shall apply to all PP requests:
 - 1. Materials or products:
 - a. On order, being shipped, etc. may not be invoiced.
 - b. Received and stored on the project site may be invoiced.
 - c. Being manufactured off site at any location may not be invoiced (example: cabinetry, ductwork, etc.)
 - d. Completed products stored off site locally waiting for delivery to the project site may be invoiced with prior approval by the CPM. All of the following conditions must be met to be allowed:
 - 1) Items must be visually inspected by CPM to verify product is complete.
 - 2) Item must be stored inside a compatible structure and the structure and contents must be insured.
 - 3) Contractor is responsible for condition until installation is completed.
 - 2. All labor and equipment, including rental time for the current progress period may be invoiced.
 - 3. Only completed installations may be invoiced to 100% based on the Schedule of Values.
- D. DO NOT submit BPW Contract Administration Documentation for review with Progress Payment Requests, submit them directly to the correct agency and in the correct format as instructed from information in your BPW Contract Award Packet instructions.

PART 2 - PRODUCTS - THIS SECTION NOT USED**PART 3 - EXECUTION****3.01 GENERAL CONTRACTOR PROCEDURE**

- A. The GC shall use the Project Management Website for each PP request.
 - 1. The GC shall subtotal the work completed to date for all of the original Schedule of Value items.
 - 2. Ensure that any newly posted change orders have been entered.
 - 3. The GC shall submit the PP request in the Project Management Website. The username and date will be automatically recorded.
 - 4. The GC shall provide the dates from and to for the PP being requested.
 - 5. The GC shall provide the list of all contractors/sub-contractors that were actively working during the dates indicated above. The guide details the appropriate location for this list.
 - a. All contractors/sub-contractors named must be in compliance with all City requirements (Pre-qualified, Affirmative Action Plan on file, etc). The PP will be held and not processed by the City of Madison until all contractors/sub-contractors are in compliance.
 - b. Do not list the names of suppliers or manufacturers, doing so will slow down processing and require a re-submittal of the paperwork.
 - 6. The GC shall attach a copy of the current Project Schedule.

3.02 CITY PROJECT MANAGER PROCEDURE

- A. The CPM shall review all documents submitted by the GC to ensure the schedule of values accurately reflects the work completed to date.
- B. The CPM may elect to hold processing of any progress payment pending submittal of required progress payment milestones.
- C. When verified, the CPM shall send the PP and required documentation to the appropriate City agencies for further processing of the payment request.

D. The PP processing will be completed and available for view on the Project Management Web Site.

END OF SECTION

**SECTION 01 31 13
PROJECT COORDINATION**

PART 1 – GENERAL

1.01 SUMMARY

- A. Project Coordination covers many areas within the execution of the Contract Documents and the requirements of proper coordination are the applicable to all contractors executing the Work of this contract.
- B. This specification provides general information regarding project coordination for the General Contractor and all Sub-contractors. All contractors shall be familiar with project coordination requirements and responsibilities that may be defined in other specification within these Contract Documents.
- C. The General Contractor shall at all times be responsible for the project, project site, and execution of the Contract Documents.

1.02 RELATED SPECIFICATIONS

- A. Section 01 29 76 - Progress Payment Procedures.
- B. Section 01 31 19 - Progress Meetings.
- C. Section 01 31 23 - Project Management Web Site.
- D. Section 01 32 16 - Construction Progress Schedules.
- E. Section 01 32 19 - Submittals Schedule.
- F. Section 01 33 23 - Submittals.
- G. Section 01 43 39 - Mockups.
- H. Section 01 45 16 - Field Quality Control Procedures.
- I. Section 01 60 00 - Product Requirements.
- J. Section 01 77 00 - Closeout Procedures, including all specifications referenced therein.
- K. Section 01 91 00 - Commissioning.

1.03 GENERAL REQUIREMENTS

- A. The following general requirements shall applicable to all contractors:
 - 1. Cooperate with the Owner, all authorized Owner Representatives, Project Architect and all consultants of the Owner.
 - 2. Materials, products, and equipment shall be new, as specified and to industry standards except where otherwise noted.
 - 3. Labor and workmanship shall be of a high quality and to industry standards.
- B. Existing conditions:
 - 1. Verify all existing conditions indicated in the contract documents with actual field locations and take field measurements to verify existing conditions. Field verify dimensions including sizes and locations of existing architectural components, existing structural systems, existing equipment, existing mechanical and utility components, and similar items including any existing condition related to the work.
 - 2. Report any inconsistencies, errors, omissions, or code violations in writing to the General Contractor (GC) immediately.
 - 3. Annotate any inconsistencies, errors, omissions on the GC As-Built record drawings immediately for future reference.
- C. Contract Documents:
 - 1. The Contract Documents are intended to include everything necessary to perform the work. Every item required may not be specifically mentioned, shown, or detailed.

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- a. Except where specifically stated all systems and equipment shall be complete, installed, and fully operable.
 - b. If a conflict exists within the contract documents the contractor shall furnish the item, system, or workmanship of the highest quality, largest, largest quantity, or most closely fits the intent of the contract documents.
 - c. Manufacturers recommended installation details shall be verified and used prior to installation of products and equipment so as to not void warranties.
 - D. Errors and Omissions
 - 1. No Contractor shall take any advantage of any apparent error or omission in the construction documents.
 - 2. The City of Madison shall be permitted to make such corrections and interpretations as may be deemed necessary for the fulfillment of the intent of the construction documents.
 - E. Owners Representatives
 - 1. All contractors shall be familiar with various Owner Representatives having Quality Management responsibilities for the duration of this project including but not limited to the following:
 - a. Project Architect, responsible for all decisions affecting the code compliance and design intent of the construction documents.
 - b. Consulting Architects and Engineers, responsible for providing consulting services to the Project Architect, Owner, and City Project Manager, also responsible for Quality Management of the construction documents.
 - c. Owner, the designated representative of the City Agency that will occupy the project upon completion.
 - d. City Project Manager, responsible for all day to day decisions regarding the execution and performance of this Public Works Contract.
 - e. Consulting City Staff, responsible for providing consulting services to the Project Architect, Owner, and City Project Manager, also responsible for Quality Management of the construction documents.
 - f. Commissioning Agent (CxA), responsible for ensuring that the project is meeting the Owner's Project Requirements and related quality assurance procedures.
 - 2. Owner Representatives shall be attending progress meetings, pre-installation meetings, performing or being present for final testing and acceptance and quality management reporting during the execution of the contract documents as outlined in other specifications.

1.04 GENERAL CONTRACTOR PERFORMANCE REQUIREMENTS

- A. Assume the responsibility for all Work specified in the Contract Documents except where specifically identified to be performed by the Owner or other contractor separately hired by the Owner.
 - 1. Coordinate all work by Owner, equipment provided Owner, or contractor hired by the Owner into the project schedule.
- B. Provide all construction management responsibilities as specified in other Division 1 specifications including but not limited to:
 - 1. Scheduling of work.
 - 2. Coordination of work between other Trades and Sub-contractors.
 - 3. Construction administration and management.
 - 4. Site layout, cleanliness, and protection of completed work/stored materials.
 - 5. Waste Management.
 - 6. Quality Assurance and Quality Control.
- C. Use Diggers Hotline and private utility locating companies to accurately locate all public and private utilities on the property as needed. The GC is responsible for any repair or replacement to any public or private utility damaged during the execution of the Work

- D. Report any inconsistencies, errors, omissions, or code violations in writing to the Project Architect immediately. Failure to report inconsistencies prior to beginning work shall indicate that the GC accepted all existing conditions.
- E. The GC shall be responsible for assigning work and related responsibilities where the Contract Documents may not clearly state who is responsible for providing the work, material, or product.
- F. Provide construction management oversight of all items described in Section 1.05 below.
- G. Coordinate and assist CxA as outlined within 01 91 00 and as directed by Owner.

1.05 SUB-CONTRACTOR PERFORMANCE REQUIREMENTS

- A. Be familiar with all of the contract documents as they pertain to your Work, adjacent work and the overall progress of the project.
 - 1. All Sub-contractors shall be familiar with all Division 1 specifications as they may apply to progress, progress payments, quality control construction management, and closeout of the contract.
- B. Coordinate your Work with all adjacent work and existing conditions.
 - 1. Perform your work in proper sequence according to the GC's project schedule and in relation to the work of other trades.
 - 2. Notify other sub-contractors and trades whose work may be connected to, combined with, or influenced by your work and allow them reasonable time and access to complete their work.
 - 3. Join your work to the work of others in accordance with the intent of the Contract Documents.
 - 4. Order materials and schedule deliveries to facilitate the general progress of the Work.
- C. Cooperate with all other trades to facilitate the general progress of the work. This shall include providing every reasonable opportunity for the installation of work by others and the storage of their materials and equipment.
 - 1. In no case shall any contractor exclude from the premises or work any Sub-contractor or their employees.
 - 2. In no case shall any contractor interfere with the execution or installation of Work by any other Sub-contractor or their employees.
- D. Arrange your work, equipment, and materials and dispose of your construction waste so as to not interfere with the work or storage of materials of others.
- E. Coordinate all work as indicated during pre-installation meetings with Owner Representatives, the GC and other trades. Any work improperly coordinated shall be relocated as designated by the Owner Representative at no additional cost to the City.
- F. Coordinate and assist CxA as outlined within Section 01 91 00 - Commissioning, and as directed by Owner.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 – EXECUTION – THIS SECTION NOT USED

END OF SECTION

**SECTION 01 31 19
PROJECT MEETINGS****PART 1 – GENERAL****1.01 SUMMARY**

- A. The purpose of this specification is to identify various project related meetings and the responsible parties for scheduling, agendas, minutes, and required attendance.
- B. This specification is not intended to be inclusive of all meeting types or a complete list of required meetings.
- C. This specification is not intended to cover planning and execution meetings between the General Contractor (GC) and their sub-contractors.

1.02 RELATED SPECIFICATIONS

- A. 01 31 23 - Project Management Web Site.
- B. 01 32 16 - Construction Progress Schedules.
- C. 01 43 39 - Mockups.
- D. 01 91 00 - Commissioning.

1.03 PROJECT MEETING TYPES

- A. The following project meeting types may be used but not limited to the following
 - 1. Preconstruction Meeting.
 - 2. Project Management Web Site – Tutorial Meeting.
 - 3. Construction Progress Meetings.
 - 4. Pre-installation Meetings (including mock-up review meetings).
 - 5. Weekly Trade Meetings.
 - 6. Special Meetings.
 - 7. Commissioning Meetings.

1.04 GENERAL REQUIREMENTS

- A. Representatives of Contractors, Subcontractors, and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.

PART 2 – PRODUCTS – NOT USED IN THIS SECTION**PART 3 - EXECUTION****3.01 PRECONSTRUCTION MEETING**

- A. After execution of the Contract the City Project Manager (CPM) shall schedule and conduct the Preconstruction Meeting at the Owner's facilities. The CPM shall coordinate the meeting agenda with the Project Architect and the GC Project Manager.
- B. The CPM shall be responsible for the final agenda.
- C. The CPM and Project Architect shall take notes on the meeting and post completed meeting minutes.
- D. Attendance shall be required by all of the following:
 - 1. Owner Representative(s).
 - 2. Architect and applicable sub consultant(s).
 - 3. General Contractor and applicable subcontractors and suppliers.
 - a. Including Project Manager and Site Supervisor.
 - b. Including all Prime Sub-Contractors (Civil, MEP, Technology, Fire Protection).
 - c. Other Sub-Contractors as necessary.
 - d. Suppliers of major materials/supplies as necessary.
 - 4. City Quality Management Staff.
 - 5. Commissioning Agent.

6. Others, as may be invited for particular agenda items.
- E. Topics of the Preconstruction Meeting shall include but not be limited to the following:
 1. Staff and contractor introductions.
 2. Completion Date.
 3. BPW Administrative requirements and due outs.
 - a. Small Business Enterprise (SBE) (if applicable).
 - b. Certified payroll forms.
 - c. Workforce profiles.
 - d. Best Value Contracting (BVC).
 4. General Facility Management Division 1 Specifications, including:
 - a. Section 01 29 76 - Progress Payment Procedures.
 - b. Section 01 31 23 - Project Management Web Site (overview).
 - c. Section 01 45 16 - Field Quality Control Procedures.
 - d. Section 01 77 00 - Closeout Procedures.
 - e. Section 01 91 00 - Commissioning.
 5. Project Meeting scheduling
 - a. Section 01 31 19 - Project Meetings.
 6. Construction Schedule.
 7. Commissioning Process.

3.02 PROJECT MANAGEMENT WEB SITE (PMWS) – TUTORIAL MEETING

- A. The CPM shall schedule and conduct a virtual tutorial presentation of the PMWS prior to the beginning of construction.
- B. The CPM shall be responsible for the final agenda, there will be no minutes.
- C. The required attendance list in 3.1.D. above shall apply except for City Staff in items 1 and 4 who are already familiar with the PMWS system.

3.03 CONSTRUCTION PROGRESS MEETINGS

- A. In general, all of the following shall apply:
 1. Representatives of Contractors, Subcontractors, and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.
 2. The attendance shall be from the required attendance list in 3.01.D. above.
 - a. Prime Sub-Contractor Project Managers (Mechanical, Electrical, Plumbing, and Fire Protection) shall be required to attend all progress meetings until such time as their work is completed.
 - b. All Sub-Contractor and Sub-Sub-Contractor Project Managers who have work scheduled during the 6 week look ahead schedule will be required to attend progress meetings.
- B. The General Contractor Project Manager (GCPM) shall:
 1. Schedule and conduct all construction progress meetings biweekly or more frequently as required.
 2. Prepare agenda for meetings including, but not limited to the following:
 - a. Safety.
 - b. Current Schedule, including review of the critical path and 6-week look ahead schedule.
 - c. Status of project related documentation (Submittals, RFIs, CBs, etc.).
 - d. Quality Observation Log and status of correction of deficient items.
 - e. Project questions and issues from meeting attendees.
 - f. BPW Administration Check.
 - g. Other as needed.
 - h. Status of CORs and COs to be reviewed outside the standard progress meeting time.
 3. Make physical arrangements for meetings.

4. GCPM to post meeting agendas to the appropriate libraries on the Project Management Web Site (PMWS) no less than two (2) working days prior to the scheduled meeting. Notify all required attendees, applicable parties to the contract, and others affected of the posted meeting agenda.
5. Preside at meetings.
6. Route a meeting attendance roster for attendees to sign-in on.
7. GCPM to record the minutes of the meeting; include significant proceedings and decisions. Post meeting minutes to the PMWS no more than two (2) working days after the completed meeting. Meeting minutes shall include a scanned copy of the attendance sign-in sheet. Notify all required meeting attendees, applicable parties to the contract, and others affected by decisions made at the meetings.
8. The above requirements do not apply to GC/sub-contractor meetings.

3.04 PRE-INSTALLATION MEETINGS

- A. The GCPM shall schedule and conduct all pre-installation meetings, including mockup reviews, before each construction activity that requires coordination with other trades.
- B. The GCPM shall be responsible for the final agenda and meeting minutes.
- C. The GCPM will work with all concerned parties to resolve issues as needed and submit RFI's if necessary.
- D. Required attendance shall be from the list in 3.1.D. above and shall be personnel having a stake in the outcome of the installation or knowledge of the system being installed.
- E. In the event the Contractor installs equipment or materials without a pre-installation meeting the Contractor shall be solely responsible for removing, replacing, repositioning materials and equipment as instructed by the Project Architect or City Project Manager at no additional cost to the City.

3.05 PRE-CONTRACT CLOSEOUT MEETINGS

- A. Two (2) Pre-contract Closeout Meetings shall be held to review the closeout procedures, requirements, and contract deliverables.
 1. Pre-contract Closeout Meeting #1 shall be scheduled prior to the 50% Progress Payment Request is being requested. This meeting shall discuss items such as closing out QMO reports, providing O&M drafts and finals, payroll and Affirmative Action documentation, and other contract deliverables.
 2. Pre-contract Closeout Meeting #2 shall be scheduled prior to the 80% Progress Payment Request is being requested. This meeting shall discuss, but not be limited to, the status of scheduling final regulatory inspections, cleaning up outstanding QMO's, demonstration and training, attic stock; and finalization review of payroll and other related documents.
- B. The GCPM shall schedule, coordinate, and make physical arrangements for both meetings.
- C. All of the following shall be required to attend both meetings:
 1. The GCPM and the GC Field superintendent
 2. All Subcontractor Project Managers regardless of the current status of their work.
 - a. The GCPM may excuse a Subcontractor PM if they are confident that all contractual requirements for closeout by the subcontractor have been completed and/or delivered to the GCPM. The list of attendees shall be reviewed and agreed upon with CPM ahead of the meeting.
 - b. At the option of these project managers the field supervisors may also attend.
 3. The Project Architect and at least one design consultant from each discipline represented by the plans and specifications to address open QMOs, final tests, reports, etc.
 4. The Owner.
 5. The CPM.
 6. Quality Management staff as needed to address open QMOs, final tests, reports, etc.
 7. The Commissioning Agent.

- D. The CPM shall publish an agenda and chair the meeting.

3.06 OTHER SPECIAL MEETINGS

- A. The Contractor shall schedule special meetings per the requirements of the LEED Specification, the Project Quality Management Plan, the Commissioning Plan and as indicated by other specifications.
- B. Special meetings include but are not limited to the following:
 - 1. Waste Management Conference.
 - 2. Equipment start up meetings.
 - 3. Testing and balancing meetings.
 - 4. Commissioning meetings.
 - 5. Other meetings as necessitated by the contract documents.

END OF SECTION

SECTION 01 31 23 PROJECT MANAGEMENT WEB SITE

PART 1 – GENERAL

1.01 GENERAL DESCRIPTION

- A. The City of Madison (CoM) has established a cloud-based Project Management Tool (PMT) using an Autodesk product called Autodesk Construction Cloud (ACC).
 - 1. This Project Management Website is often referred to throughout this document as PMWS.
- B. The software is used throughout the design, construction and warranty process of major remodels and new construction projects.
- C. Initially deployed in mid-2023, the PMT software will be deployed on all projects. The PMT software is cloud-based software and therefore will receive regular updates and enhancements.

1.02 AUTODESK CONSTRUCTION CLOUD (ACC) PROCEDURE OVERVIEW

- A. The CoM PMT is 3 main modules. The [Autodesk Docs \(https://help.autodesk.com/view/DOCS/ENU/\)](https://help.autodesk.com/view/DOCS/ENU/) module is a document management file system that is the foundation of ACC. The [Build \(https://help.autodesk.com/view/BUILD/ENU/\)](https://help.autodesk.com/view/BUILD/ENU/) module has many sections that assist in performing day to day functions of design/construction management while reducing the use of different software platforms, surface mail, email and email attachments. Finally, the [Cost management \(https://help.autodesk.com/view/BUILD/ENU/?guid=Cost_Overview\)](https://help.autodesk.com/view/BUILD/ENU/?guid=Cost_Overview) project finances.
 - 1. Files within Autodesk Docs can store a wide variety [file formats \(https://help.autodesk.com/view/DOCS/ENU/?guid=Supported_Files_Docs\)](https://help.autodesk.com/view/DOCS/ENU/?guid=Supported_Files_Docs) including but not limited to Word, Excel, PDF, photographs (all popular formats), etc.
 - 2. The Issues section within the Build module is used for Punch Lists, Quality Control and Warranty issues.
 - 3. File Folder and module section access are controlled by Permission Groups and Permission Level.
- B. A tutorial document on the web based PMT will be provided to the General Contractor (GC) who is awarded the contract. Additional training will be provided as needed for the GC and Sub-Contractors (SC) by the CoM.
- C. The PMT has predefined work flows that channel automated alerts as documents are uploaded, reviewed, and completed. These workflows are designed for inbound information from the contractor as well as outbound information from the Architectural/Engineer consultant and the Owner.
- D. The GC will be required to receive email notifications, access the internet to review related documentation and be able to upload/download documentation to the various project modules or folders.
- E. The SC's will be required (at a minimum) to receive email notifications and access the internet to review related documentation. Prior to setting up the final PMT the GC and CPM shall meet to review all ACC workflows, the GC will determine to what level over the minimum requirements the SC's will be involved.
- F. At final project closeout with the GC, the CoM will provide the Project Architect/Project Engineer (A/E PROJ MGR) and the GC, an exported version of the complete project in ACC.

1.03 RELATED SPECIFICATIONS

- A. The following specification sections are directly related to the CoM PMT system.
 - 1. 01 25 13 - Product Substitution Procedures.
 - 2. 01 26 13 - Request for Information (RFI).
 - 3. 01 26 46 - Construction Bulletins (CB).
 - 4. 01 26 57 - Change Order Request (COR).
 - 5. 01 26 63 - Change Order (CO).
 - 6. 01 29 76 - Progress Payment Procedures.

7. 01 31 19 - Project Meetings.
8. 01 32 16 - Construction Progress Schedules.
9. 01 32 26 - Construction Progress Reporting.
10. 01 32 33 - Photographic Documentation.
11. 01 33 23 - Submittals.
12. 01 45 16 - Field Quality Control Procedures (Owner).

PART 2 - PRODUCTS

2.01 AUTODESK CONSTRUCTION CLOUD SYSTEM RELATED PRODUCTS

- A. Autodesk Construction Cloud is an Autodesk based software that requires no additional software installation, hardware or other special requirements/applications for the users. There are no costs associated with the use of this system.
- B. Please consult Autodesk's web site for the [latest system requirements](https://help.autodesk.com/view/BUILD/ENU/?guid=System_Requirements_ACC) (https://help.autodesk.com/view/BUILD/ENU/?guid=System_Requirements_ACC)

PART 3 - EXECUTION

3.01 POST BID-OPENING

- A. After bids have been opened, a successful bidder has been determined, and bid acceptance procedures have been initiated the City Project Manager (CPM) will contact the GC to provide the following information.
 1. 1. [Autodesk Construction Cloud Help \(https://help.autodesk.com/view/BUILD/ENU/\)](https://help.autodesk.com/view/BUILD/ENU/) and [Learning Center \(https://learnacc.autodesk.com/\)](https://learnacc.autodesk.com/) are kept up to date with latest ACC features.
 2. 2. For more customized workflows, Project Management Software Tutorials have been developed. These tutorials are in a PDF printable format with screen shots and associated instructions on how to access and use the PMT.
 3. 3. A blank Project Directory in an Excel spread sheet format. The contractor shall provide the following information for GC and SC staffs as indicated on the spreadsheet. This will generally be the Project Manager for the GC as well as the Sub-contractors and the GC Site Supervisor.
 - a. Last Name, First Name
 - b. Company Name
 - c. Email address (valid, work related)
 4. 4. Phone Contact number and professional name must be entered by each user themselves via <https://profile.autodesk.com/>
 5. The GC shall provide the above information for all SC's where the GC is not self-performing the work.
 6. The GC may provide project foreperson information for work being self-performed if he/she so desires.

3.02 POST PRE-CONSTRUCTION MEETING

- A. The GCPM will return the completed Project Directory spread sheet to the CPM no later than the Pre-construction meeting.
- B. The City Project Admin is responsible for uploading all project directory data into ACC, adding users to project and licenses to users for all non-city staff (GC/SC staffs).
- C. All GC/SC staff will be notified through an automated email from Autodesk directing them to create an Autodesk account if they do not already have one. It is the responsibility of each GC/SC to follow the instructions to setup their own account
- D. Once the GCPM has received his/her project invitation, uploading of contract related documents can begin. This would include but not be limited to project schedules, submittals, RFI's, and other documents as needed.
- E. All workflows, review of documentation, and general archiving of construction related documentation will be conducted on the PMWS. These documents will generally not be emailed.

- F. The following documents related to the execution of the contract will not be part of the PMT:
1. All documentation related to executing the contract, such as:
 - a. Sub Contractors list.
 - b. Affirmative Action documentation.
 - c. Bonding documentation.
 - d. Documentation associated with payroll verification.
 - e. Final documentation associated with closing out the contract.
 2. Any documentation required/generated by ordinance, code or statute, such as;
 - a. Erosion Control inspections.
 - b. Building Inspection Department inspections.

END OF SECTION

SECTION 01 32 16
CONSTRUCTION PROGRESS SCHEDULES

PART 1 – GENERAL

1.01 SCOPE

- A. This specification is to identify various project related schedules associated with indicating construction progress and outlook. The following schedules are the responsibility of the General Contractor (GC).
 - 1. Overall Project Schedule.
 - 2. 6 Week Look-out Schedule.
- B. This specification is not intended to include internal schedules generated by the contractors during their planning and execution of the contract.

1.02 RELATED SPECIFICATIONS

- A. Section 01 29 76 - Progress Payment Procedures.
- B. Section 01 31 23 - Project Management Web Site.
- C. Section 01 31 19 - Progress Meetings.
- D. Section 01 74 13 - Progress Cleaning.
- E. Section 01 77 00 - Closeout Procedures.
- F. Section 01 78 23 - Operation and Maintenance Data.
- G. Section 01 78 36 - Warranties.
- H. Section 01 78 39 - As-Built Drawings.
- I. Section 01 78 43 - Spare Parts and Extra Materials.
- J. Section 01 79 00 - Demonstration and Training.
- K. Section 01 91 00 - Commissioning.
- L. Other specification within the construction documents that may indicate the need for scheduling any event with Owner, Project Architect, Owner Representatives, including any owner provided equipment.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.01 OVERALL PROJECT SCHEDULE (OPS)

- A. The GC shall prepare an OPS that covers the duration of the contract from the pre-construction meeting through the end of construction to final contract closeout.
 - 1. The GC shall review Specification 01 77 00 - Closeout Procedures to become familiar with definitions, differences, and requirements for closing out the construction and contract including the association with progress payments.
- B. The GC shall provide copies and lead a discussion on the OPS during the pre-construction meeting.
- C. The OPS shall indicate start and end dates of each task associated with the project.
- D. The OPS shall clearly indicate the critical path of the project.
- E. The GC shall update the OPS as often as necessary during the duration of the project. Updates will be briefed as needed during bi-weekly progress meetings.

3.02 6 WEEK LOOK-OUT SCHEDULES (LOS)

- A. The GC shall prepare the initial LOS to include detail of daily tasks for the first six (6) weeks of construction in depth for the Pre-construction meeting. The LOS shall be compatible and complimentary to the OPS.

- B. The GC shall provide copies and lead a discussion on the LOS during the pre-construction meeting.
- C. The LOS shall indicate start and end dates of each major task, associated related sub-tasks, and required parallel or pre-requisite tasks required to complete the major task on time.
- D. The LOS shall also include identifying and scheduling such events as:
 - 1. Pre-installation meetings and mock-up review meetings.
 - 2. Quality management reviews of installations before they are covered.
 - 3. Owner provided equipment as designated by the contract documents.
 - 4. Work by others as designated by the contract documents.
 - 5. Critical submittal dates.
- E. The GC shall update the LOS prior to each bi-weekly progress meeting to indicate the next 6 weeks of scheduled work. Updates will be briefed during each bi-weekly progress meeting.

3.03 PROJECT MANAGEMENT WEB SITE (PMWS)

- A. The GC shall upload all project schedules and updates to the PMWS in an original PDF version of the scheduling document. Scans will not be permitted.

END OF SECTION

SECTION 01 32 19 SUBMITTALS SCHEDULE

PART 1 – GENERAL

1.01 SUMMARY

- A. The General Contractor shall submit a complete and comprehensive list of all submittals anticipated during the execution of this contract.
- B. The GC shall include the Administrative submittals identified in item 1.5 below and shall be required to upload them to the Project Management Web Site (PMWS).
- C. The initial Submittals Schedule shall be based on the original contract documents used at the time of bidding and any posted addenda through awarding of the contract.
- D. The Submittal Schedule may be appended during the execution of the contract based on amendments to the contract in the form of Change Orders, Construction Bulletins, and other related documents that add, or change the scope of the work.

1.02 RELATED SPECIFICATIONS

- A. Section 01 29 76 - Progress Payment Procedures.
- B. Section 01 31 23 - Project Management Web Site.
- C. Section 01 33 23 - Submittals.
- D. Section 01 91 00 - Commissioning.

1.03 RELATED DOCUMENTS

- A. The following documents shall be used as the basis for initiating the original Submittals Schedule.
 - 1. Drawing documents and specifications (including general provisions) as provided with the bid set documents and any published addenda.
- B. The following documents shall be used to amend the submittals schedule as needed during the execution of this contract.
 - 1. Documents associated with revisions or clarifications to number A.1 above after awarding of the contract, including but not limited to:
 - a. Construction Bulletins.
 - b. Approved Change Orders.

1.04 SUBMITTAL DEFINITIONS

- A. Administrative Submittal: Any submittal that may be required by a Division 1 Specification and as noted in Section 1.05 below.
- B. Critical Path Submittal: Any early submittal that needs a priority review due to early construction use or long lead times where a delay could affect the critical path of the construction schedule
- C. Submittal: Any material, product, equipment, or general requirement as outlined in this and other specifications that require a favorable review or acceptance prior to proceeding with procuring the item or proceeding with the Work.

1.05 SUBMITTAL REQUIREMENTS

- A. The GC and all Sub-contractors shall review the construction documents including the specifications of their individual Division or Trade to compile a complete list of all materials, products, or equipment that will require a positively reviewed submittal to be completed prior to procurement and installation.
 - 1. Submittals shall include but not be limited to any of the following that may apply:
 - a. Shop Drawings.
 - b. Product Data.
 - c. Assembly Drawings.
 - d. Engineered Drawings.
 - e. Product Samples.
-

- B. The following items will require an approved submittal, verify with specifications for specific needs and requirements:
 - 1. Contractor certifications for specialized work such as asbestos removal, well drilling, controls, AV, etc.

1.06 ADMINISTRATIVE SUBMITTALS

- A. The GC shall upload the following submittals within 15 working days of receipt of the City of Madison Start Work Letter. All Administrative Submittals shall be approved prior to requesting Progress Payment Number 1.
 - 1. Contractors Project Directory, see specification 01 31 23, discuss requirements with CPM.
 - 2. Schedule of Values, see Specification 01 29 73.
 - 3. Submittals Schedule, see Specification 01 32 19.
 - 4. Waste Management Plan, see Specification 01 74 19.
 - 5. Closeout Requirement Checklist, see Specification 01 77 00.
 - 6. Warranty Checklist, see Specification 01 78 36.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.01 OVERALL RESPONSIBILITIES OF ALL CONTRACTORS

- A. All contractors shall be responsible for reviewing the drawings and specifications within their Divisions of Work to provide a complete and comprehensive list of submittals to the General Contractor.
- B. Each list shall indicate the title of the submittal, the associated specification of the submittal, whether the submittal can be considered an early/middle/late submittal, the anticipated date the submittal will be provided and the anticipated date the submittal needs to be approved.
- C. Contractors shall be aware that the goals for submittal review by the Architect staff and City staff will be as follows:
 - 1. For items on the Critical Path as identified by the GC, five (5) working days
 - 2. For most other submittals ten (10) working days
 - 3. Additional time may be needed for complex submittals or if re-submittals are required.
- D. The City will provide a spreadsheet to provide the format of the Submittal Schedule as part of the first administrative submittals.

3.02 GENERAL CONTRACTORS RESPONSIBILITIES

- A. The General Contractor shall be responsible for all of the following:
 - 1. Consolidating all submittal lists from individual contractors into one master list with the provided spreadsheet on the Project Management Web Site
 - 2. Reviewing all submitted lists for completeness, timing with the overall contract, etc. The GC shall meet with individual contractors to make changes as necessary.
 - 3. Upload the completed Submittals Schedule to the Submittal Library on the Project Management Web Site (PMWS). See Specification 01 33 23 - Submittals for more information on this procedure.
 - 4. Resubmit the schedule as needed after initial reviews have been completed.
- B. The GC shall work with other contractors to amend the Submittals Schedule throughout the execution of the project based on changes and modifications as needed.
- C. The GC and Project Architect shall be responsible for reviewing and briefing the submittal schedule and submittals status at each bi-weekly construction meeting.

3.03 STAFF REVIEW RESPONSIBILITIES

- A. The Project Architect, consulting staff, Commissioning Agent (CxA), Owner, and city staff will review the Submittal Schedule for completeness per the plans and specifications within their divisions of work. The reviewing staff may provide comments as needed. Some examples might include the following:
 - 1. Submittal not required.
 - 2. Provide photos of samples with digital submittal.
 - 3. Insure one submittal for complete system.
 - 4. Append the schedule to include _____.
 - 5. See Specification xyz for additional requirements.
- B. The Project Architect and City Project Manager will finalize review comments regarding the Submittal Schedule. Re-submittal of the submittal schedule may be required.

END OF SECTION

**SECTION 01 32 23
SURVEY AND LAYOUT DATA**

PART 1 – GENERAL

1.01 SUMMARY

- A. The purpose of this specification is to set forth the minimal required guidelines to be followed by the General Contractor (GC) and the Land Surveyor (Surveyor) including but not limited to the following:
 - 1. Surveyor Professional Requirements.
 - 2. Horizontal and Vertical Datum Control.
 - 3. Local Control (if any).
 - 4. Electronic File and Data Requirements.
 - 5. As-Built Documentation Requirements.
- B. When working on any City of Madison project, OSHA standards must be complied with. The Surveyor shall provide appropriate traffic control in accordance to the Manual on Uniform Traffic Control Devices (MUTCD).
- C. The Surveyor shall be responsible for notifying Diggers Hotline in advance of beginning the field work for this contract.

1.02 RELATED SPECIFICATIONS

- A. Section 01 29 76 - Progress Payment Procedures
- B. Section 01 31 23 - Project Management Web Site (PMWS)
- C. Section 01 33 23 - Submittals
- D. Section 01 78 39 - As-Built Drawings
- E. Section 105.9, Survey Points and Instructions, of the City of Madison FACILITIES MANAGEMENT SPECIFICATIONS for Public Works

1.03 SURVEYOR QUALIFICATIONS

- A. The General Contractors, Land Surveyor Sub-Contractor shall meet or exceed the following:
 - 1. The Principal Land Surveyor (PLS) shall be licensed to practice in the State of Wisconsin.
 - a. The PLS's license shall be current at the beginning of the contract and the PLS shall maintain an active license throughout the execution of this contract.
 - 2. The PLS shall have a minimum of minimum of ten (10) years of field experience on similar projects of scope and size.
 - a. Land Surveyors working under the direction of the PLS shall have a minimum of five (5) years of field experience on similar projects of scope and size.
- B. The PLS shall be responsible for checking and verifying all work being performed under the PLS's direction during the execution of this contract. This shall include but not be limited to periodic field checks of equipment and survey data for accuracy and compliance with the contract documents.

1.04 QUALITY ASSURANCE

- A. The PLS shall do all surveying in City of Madison Datum's as follows:
 - 1. All Horizontal Control shall be in the Dane County Coordinates (WISCRS), NAD 83(1997) datum, US Survey foot).
 - 2. All Vertical Control shall be in NAVD88(1991).
 - 3. Information on PLSS Section Corner Monuments and Tie Sheets can be found on the City Engineering Mapping website
http://gis.cityofmadison.com/Madison_PLSS/PLSS_TieSheets.html.

1.05 SUBMITTALS

- A. After initial project setup the PLS shall provide the following information as a Survey Data Submittal for review by the CPM/CCM, and Owner. See Specification 01 33 23 – Submittals for more information.
 - 1. Copy of the PLS (and any supporting staff) current State of Wisconsin registration certificate/licenses.
 - 2. Digital Survey Submittal shall be uploaded to the Project Management Web Site. Submittal Survey shall be in Auto CAD format. Digital Submittal shall be of the project site setup showing all of the following:
 - a. Key features not scheduled for demolition, including but not limited to building corners, roof overhangs, and door locations.
 - b. Location of construction limits fencing.
 - c. Locations of PLSS and/or project control points provided by the Owner.
 - d. Locations of project based control points.
 - 3. Printed Survey Submittal shall be the same as item 1 above in PDF format. PDF file shall be formatted to print to scale on 24"x36" sheets as required to show all features with text neatly organized for each item identified. When multiple sheets are used a match line and sheet references shall be required.
 - 4. PDF file of the complete level/layer scheme. Scheme shall be in tabular form formatted to 8.5 by 11 paper and shall include all of the following:
 - a. Level/layer designation (abbreviation).
 - b. Level/layer designation (full title).
 - c. Feature attribute characteristics (line weight, line style, font, etc.).
 - d. Cell attribute information
 - e. Samples of line styles and cells.

1.06 EXAMINATION

- A. The PLS shall be responsible for verifying all site data including the owner provided local control points (see Section 3.01 below) prior to starting the Work.
- B. Notify the Project Architect and CPM/CCM immediately if any discrepancies are discovered.

PART 2 – PRODUCTS – NOT USED**PART 3 - EXECUTION****3.01 PRE-CONSTRUCTION OWNER SUPPORT**

- A. The CPM/CCM shall provide the GC/PLS with a digital CAD seed file on or before the Pre-construction meeting.
 - 1. Seed file shall be an Auto Cad seed file using the datum indicated above. Seed file shall be delivered as a Auto Cad format as requested by the PLS.
 - a. Seed file shall be used as the PLS's initial base file for all future work on this contract.

3.02 UTILITY LOCATING

- A. The GC and/or PLS shall be responsible for notifying Diggers Hotline for all utility locate requests.

3.03 SURVEY CONTROL AND LAYOUT DATA

- A. The GC and PLS are responsible for all other survey control and layout data required to perform the work in this contract.

3.04 TOPOGRAPHIC SURVEYING

- A. The Surveyor may perform the topographic survey with properly calibrated equipment as follows:
 - 1. Total station, achieving minimum accuracy for well-defined features of +/- 0.1 feet (3.05 cm) horizontal and +/-0.04 feet (1.22 cm) vertical at 95% confidence relative to control. "Well defined features" shall include but not be limited to property irons, pavements, trees, landscaping features, buildings, utility locations, and other permanent features.
-

2. RTK GPS shall be permitted in large open areas, along tree lines, and in brushy areas.

3.05 SITE SURVEY AS-BUILT

- A. See Specification 01 78 39 - As-Built Drawings, Section 3.02 for more information on required record site information to be provided prior to contract closeout.
- B. The GC shall be responsible for scheduling the PLS to capture locations and depths of all buried utilities prior to any contractor back filling trenches. The Owner may require missing information to be located and surveyed at the GC's expense.

END OF SECTION

SECTION 01 32 26
CONSTRUCTION PROGRESS REPORTING

PART 1 – GENERAL

1.01 SUMMARY

- A. Daily records of project activities, resources used, weather conditions, and other information related to the ongoing progress of the project are extremely important at all levels of Construction Management.
- B. Daily records provide the base for weekly progress reports and updating progress schedules.

1.02 RELATED SPECIFICATION SECTIONS

- A. Section 01 31 19 - Project Meetings.
- B. Section 01 31 23 - Project Management Web Site.
- C. Section 01 32 23 - Photographic Documentation.

1.03 PERFORMANCE AND QUALITY ASSURANCE REQUIREMENTS

- A. The General Contractor (GC) shall be responsible for all Construction Progress Reporting as outlined in this and other specifications as noted.
- B. The GC shall maintain daily progress journals in a format of their choosing provided it is legible and contains the information as outlined in Section 3.01 below.
- C. The journal shall be located in the job trailer and shall be reviewable by the Project Architect or City Project Manager if so requested.

PART 2 – PRODUCTS - THIS SECTION NOT USED

PART 3 - EXECUTION

3.01 CONTRACTOR JOURNAL

- A. The GC shall maintain a journal of daily progress on which Work is performed by any employee or entity for which the GC is responsible. Such reports shall include all relevant data concerning the progress of Work activities the GC and Subcontractors are responsible for and the effect of that activity on the time of performance of the Contract.
 - 1. Some projects may not require weekly journals be kept instead of daily journals. This is at the sole discretion of the City Project Manager. A daily journal will generally be required when the contract has a significant amount of site work. A weekly journal will generally be used when a contract is interior work only.
- B. Journal entries shall be made in the Project Management Web Site (PMWS). The form consists of the following areas:
 - 1. Weather; include temperature, humidity, precipitation, wind and other related information such as significant storm events, times, and details.
 - 2. Work completed by trade.
 - 3. Delays encountered.
 - 4. Deliveries received or delayed.
 - 5. Hot issues that need to be addressed.
 - 6. Safety issues.
 - 7. Photograph progress and upload to the Photo Library on the Project Management Web Site.
 - 8. Other including inspections, testing, etc.
 - 9. Space for attaching documents.
- C. Contractor Daily/Weekly Report Forms shall be completed and signed by the GC's Job Superintendent or other on-site representative authorized by the GC confirming each such report is current, accurate and complete.

- D. If applicable the GC shall include schedules of quantities and costs, progress schedules, wage rates, reports, estimates, invoices, records and other data as requested by the CPM concerning Work performed or to be performed under this Contract if the CPM determines such information is needed to substantiate Change Order proposals, claims, or to resolve disputes.

3.02 CONSTRUCTION PROGRESS MEETINGS

- A. The GC shall provide a verbal summary of the previous two (2) weeks progress reports at each bi-weekly construction progress meeting.

END OF SECTION

SECTION 01 32 33
PHOTOGRAPHIC DOCUMENTATION

PART 1 – GENERAL

1.01 SCOPE

- A. The General Contractor (GC) shall be required to take weekly digital photographs of interior and exterior construction progress and upload the photos directly to the Autodesk Construction Cloud (ACC) on the Project Management Website (PMWS).
- B. The GC shall be required to provide digital time-lapse photo service of the project exterior -or interior when applicable- construction progress. Exterior or interior location determination to be confirmed with City Construction Manager (CPM).

1.02 RELATED SPECIFICATION SECTIONS

- A. Section 01 29 76 - Progress Payment Procedures.
- B. Section 01 31 23 - Project Management Web Site.
- C. Section 01 32 19 - Submittals Schedule.
- D. Section 01 32 33 - Submittals.
- E. Section 01 77 00 - Closeout Procedures.

1.03 SUBMITTALS

- A. The GC shall provide general information on the type of camera being used for interior and exterior digital photographs.
 - 1. Information may be written on Contractor's transmittal sheet.
 - a. Include camera name/type, aspect ratio setting, and average file size.
 - b. Provide sample project pictures as part of PDF submittal.
- B. The GC shall provide sufficient information on the type of time lapse system being used that meets the requirements identified in section 2.02 below.

PART 2 – PRODUCTS

2.01 DIGITAL CAMERA

- A. All digital photographs shall be taken with a good quality digital camera, cell phone, tablet, and other such digital device.
- B. Digital photographs shall be formatted to achieve a good, clear, and detailed image where the final file size is between 600 KB and 3.0 MB (3000KB).

2.02 TIME LAPSE CONSTRUCTION CAMERA (TLCC)

- A. The TLCC shall be a high quality weather proof camera owned and operated, or leased, by the GC for the duration of this contract with the following minimum capabilities:
 - 1. Pan-Tilt-Zoom (PTZ) capable.
 - 2. Wireless internet or built in cellular technology capable.
 - a. The use of memory cards will not be permitted.
 - 3. Widescreen, high resolution (5-30 MP rating).
 - 4. Powered by 120V AC.
 - a. The use of battery packs will not be permitted.
 - 5. Web/cloud hosted access to archived photos and video.
 - 6. Provides complete time lapse video capability.
 - 7. 24/7 service and support for equipment, software, and hosting services.
- B. Approved equipment/services include but are not limited to the following:
 - 1. OxBlue Corporation: www.oxblue.com
 - 2. EarthCam: www.earthcam.net

3. TrueLook: www.truelook.com
4. Evercam: www.evercam.com

PART 3 – EXECUTION

3.01 REQUIREMENTS FOR DIGITAL PHOTOGRAPHS

- A. The GC shall take a minimum of two (2) exterior photographs each week. Exterior photographs will not be required on projects that do not include any exterior work.
 1. Exterior photos shall be taken from approximately the same location each week for the duration of the project.
 2. When applicable this requirement shall begin prior to commencing any site work.
 3. This requirement shall only be applicable when there is exterior work actively being conducted with the project. Periods of inactivity due to weather (winter conditions) do not require a photograph.
 4. This requirement shall end when the exterior work has been substantially completed.
 5. This requirement may be suspended due to weather conditions or substantial delays in exterior progress.
- B. The GC shall take interior photographs each week that document interior construction progress.
 1. This requirement will begin when exterior wall framing begins.
 - a. When an interior remodeling project includes demolition work interior photos shall be taken during the demolition process.
 2. Pictures do not need to be taken from the same location each week.
 3. This requirement shall end when the interior work has been substantially completed.
- C. Digital photographs shall be properly zoomed in/out, and flash used as needed, to capture a level of detail required to properly show the progress being captured by the photograph.
 1. Blurry and dark pictures will not be accepted.
- D. The camera default naming convention is acceptable. The GC does not need to rename or specifically identify pictures with a title.
- E. All digital photographs shall be saved in a JPEG (.jpg) format and uploaded directly to the Project Management Web Site (PMWS).

3.02 REQUIREMENTS FOR TIME LAPSE PHOTOGRAPHS

- A. The GC shall be responsible for all of the following:
 1. Install an approved operation timelapse camera within 30 days after date fixed by Start Work Letter and/or Notice to Proceed
 2. Verify with the CPM/CCM a suitable place for mounting the camera and related equipment prior to installation.
 3. The complete installation, setup, maintenance, and removal of the camera and related equipment.
 4. The hosting and access of all photographs and videos taken by the camera during the project.
 5. Production of a final time lapse video (minimum of 3 minutes in length) of the project provided in a viewable format to the Owner on a thumb drive or CD.
- B. Time lapse photos shall be taken from the same fixed position at approximately ten (10) minute intervals.
 1. Time lapse shall start before normal daily activities begin and end after normal daily activities have been completed.
 - a. The GC shall adjust the camera time lapse schedule as needed to accommodate any periods of overtime or weekend work.
 - b. Time lapse shall not be taken during major periods of no activity including night hours, holidays, weather related (winter) inactivity, etc.

- C. All photos taken during the execution of this contract shall be accessible from a web-based service. Archived photos shall be organized by date and time so that they can be easily retrieved and viewed as needed.
 - 1. If necessary, the GC shall coordinate usernames and passwords for access to the photos. The City of Madison would prefer that the access be generic to accommodate a wide audience.

END OF SECTION

SECTION 01 33 23
SUBMITTALS**PART 1 – GENERAL****1.01 SUMMARY**

- A. The General Contractor (GC) shall be responsible for providing submittals for review of all contractors and sub-contractors as designated in the construction documents. Submittals shall include but not be limited to all of the following:
 - 1. Equipment specified and pre-approved in the specification; to ensure quality, construction, and performance specifications have not changed since final design.
 - 2. Equipment specified by performance in the specification; to ensure that the intended quality, construction, and performance specified is met by the selected material or product.
 - 3. Shop, piece, erection, and other such drawings as indicated in the specifications to ensure all structural, dimensional, and assembly requirements are being met.
 - 4. Submittals indicating installation sequencing
 - 5. Submittals indicating control sequencing
 - 6. Contractor licensing, certification, and other such regulatory documentation when required by a specification.
 - 7. Other submittals as may be required by individual specifications.
- B. The submittal process shall not be used to determine alternates to specified products or equipment. All considerations shall be reviewed during the bidding process and acceptable alternates shall be acknowledged by addendum prior to the closing of bidding. See bidding instructions for the information on submitting alternates for consideration.
- C. In the event that a manufacturer has significantly changed a product (discontinued a model, changed dimension or performance data changed available colors, etc.) since bid opening the GC shall submit a Request for Information (RFI) to the Project Architect requesting other approved alternates prior to uploading a digital submittal.
- D. Contractors and sub-contractors shall be responsible for knowing the submittal requirements of ALL sections within their scope of work under the contract. The Owner reserves the right to request documentation on any materials, equipment, or product being installed where a submittal is not on file. If the material, equipment, or product installed is determined not to meet the intent of the specification the contractor/sub-contractor shall be required to remove and replace the items involved. The GC shall be solely responsible for all costs associated with the removal and replacement.
- E. Doors, Frames and Hardware Submittals - After submission of all door/frame/hardware submittals (and related low voltage door hardware submittals), Contractor will organize a meeting(s) with Owner, Architect, General Contractor, Electrician, Door/Frame/Hardware Supplier(s)/Installer(s), Low-Voltage Supplier/Installer, and others as applicable to comprehensively review and explain each door opening's submitted hardware package operation. Prior to this meeting the low voltage contractor shall have completed a review with the Madison Fire Department for all access control doors and be prepared to explain any conflicts or concerns with all parties. No procurement of door hardware (and related low voltage components) shall be procured until this meeting is completed; and until related submittals are returned to by the Owner/Architect team.

1.02 RELATED REFERENCES

- A. Section 01 29 76 - Progress Payment Procedures.
- B. Section 01 31 23 - Project Management Web Site (PMWS).
- C. Section 01 32 19 - Submittals Schedule.
- D. Section 01 32 26 - Construction Progress Reporting.
- E. Section 01 91 00 - Commissioning.

- F. All Technical Specifications, contract documents, construction drawings, and any published addendums during the bidding process.
- G. All contract documents generated during the execution of the contract including but not limited to Requests for Information (RFI) and Construction Bulletins (CB).

1.03 SUBMITTAL REQUIREMENTS

- A. A completed submittal shall meet the following requirements:
 - 1. Digital submittal shall be original PDF of manufacturer's data sheets or high quality color scan of the same.
 - a. Submittals shall not include sales fliers or other similar documents that typically do not provide complete manufacturers data.
 - 2. Documents within the PDF submittal shall be printable to a sized sheet no less than 8-1/2 by 11 inches and no larger than 24 by 36 inches.
 - 3. At the beginning of each submittal the contractor shall identify the plan reference (WC-1, EF-3, etc.) in RED block letters that the submittal is for.
 - 4. Where multiple model numbers appear in a table the contractor shall identify the specific model being submitted by using a RED square, box, or other designation to distinguish the correct model from others on the page.
- B. A complete submittal will include all information associated with the product or equipment as presented in plans, equipment tables, and specifications. Information shall include but not be limited to the following:
 - 1. Dimensional data.
 - 2. Performance data.
 - 3. Resource requirements, power, water, waste, etc.
 - 4. Clearance and maintenance requirements.
 - 5. Finish information, colors, textures, etc.
 - 6. Warranty information.
- C. Where a submittal includes material samples (carpet, tile, paint draw downs, etc.) the contractor shall do the following:
 - 1. The Contractor shall submit the sample(s) as indicated in the specification.
 - 2. The Contractor shall include a quality photograph(s) of the product with the digital submittal. Photographs shall meet the following requirements:
 - a. Formatted to be between 500Kb and 1.0 Mb in file size.
 - b. Have no glare or flash reflection on the sample.
 - c. Sample fills the frame of the photo and shows detail as needed. Include multiple photos from other angles as needed.
 - d. Scanned copies of products or photos are not acceptable.
- D. Uploaded submittals should be relative and related to a specific written specification.
 - 1. Do not upload submittals under a broad category or division (I.E. HVAC 23 00 00). Always upload by the specific specification that identifies a required product or performance to be met.
 - 2. Group related items together if the specification is written that way. (I.E. all of the plumbing fixtures and trim relative to one specific specification should be submitted together).

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.01 GENERAL CONTRACTOR'S PROCEDURES

- A. All required submittals will be uploaded to the Project Management Web Site (PMWS) by the GC.
 - 1. Fill in required information on the form that will be used for routing the review and comments.
 - 2. Attach all documentation as described in Section 1.03 above.
 - a. Submit samples under separate cover to the Project Architect when necessary.

- B. Uploading the submittal indicates that the GC has reviewed and approved the submittal against the contract document requirements.
- C. The GC shall discuss submittal status at all progress meetings and shall monitor submittal review/approval/re-submittal so as to not incur delays in the project schedule.
- D. A completed upload of the submittal to the PMWS initiates the review process workflow.
- E. The GC and sub-contractors shall provide re-submittals as required.

3.02 SUBMITTAL REVIEW

- A. Upon completion of the submittal upload by the GC the PMWS automatically notifies the appropriate Architect/Engineer and Owner Representative, including CxA, by Division/Specification number that there is a submittal for review.
- B. The submittal shall be reviewed internally by the required Architect/Engineer and Owner Representative and CxA in a timely fashion and provide commentary on missing items, incorrect information, or incomplete shop drawings, etc as needed.
- C. When the internal review is completed the PMWS will notify the Project Architect the submittal is ready for final review.

3.03 PROJECT ARCHITECT'S REVIEW

- A. Upon completion of the internal review the Project Architect (PA) shall review all internal review comments, confer with the CPM and CxA as needed and determine the appropriate disposition status for the submittal (approved or resubmit).
- B. The Project Architect shall summarize final internal review comments onto the submittal cover sheet, provide a final disposition of the submittal and update the review status of the submittal to "Complete..." (with or w/o comments) or "Rejected".
- C. A completed Final Review status will be completed by the City Project or City Construction Manager and initiates the PMWS to notify the GC and appropriate sub-contractor(s) that the review of the submittal has been completed.

END OF SECTION

**SECTION 01 41 00
REGULATORY REQUIREMENTS**

PART 1 – GENERAL

1.01 REQUIREMENT INCLUDED

- A. Unless otherwise specifically directed by Contractor each Subcontractor and each Sub-subcontractor shall comply with provisions of this Section as required for proper execution and completion of their Work or portions thereof.

1.02 PROCEDURES

- A. Comply with and give notices required by applicable laws, statutes, ordinances, codes, rules, and regulations, and lawful orders of public authorities having jurisdiction applicable to performance of the Work. Comply with and give notices required by Owner's and Contractor's insurance companies, local utilities and labor regulations relating to the performance of the Work, the protection of adjacent property, and the maintenance of passage ways, guard fences and other protective facilities.
- B. The Contractor shall acquire all permits, licenses, and approvals necessary for the execution of this Contract and performance of the Work and provide evidence of such applicable permits, licenses, and approvals at the Pre-Construction Meeting or before commencement of the Work.
- C. Where Contract Documents require abatement of asbestos containing materials, prior written Notice to the State of Wisconsin, Department of Natural Resources is required. The Contractor shall provide evidence of such Notice prior to commencement of the Work.
- D. Procure all certificates of inspection, use, and occupancy, and all permits and licenses, pay all charges and fees and give all notices necessary and incidental to the due and lawful prosecution of the Work. Certificates of inspection, use and occupancy shall be delivered to the Owner upon completion of the Work in sufficient time for occupation of the Project in accordance with the approved schedule for the Work. The costs of such procurement, payment and delivery shall be included within the Base Bid.
- E. Exercise precaution at all times for the protection of persons (including employees) and property. Observe the safety provisions of applicable laws, building and construction codes. Refer to the Manual of Accident Prevention in Construction, published by the Associated General Contractors of America.
- F. It is not Contractor's responsibility to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, and rules and regulations. However, if Contractor observes that portions of the Contract Documents are at variance therewith, Contractor shall promptly notify A/E and Owner in writing, and necessary changes shall be accomplished by appropriate Modification.
- G. If Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities having jurisdiction, the Contractor shall assume full responsibility for such Work and shall bear the costs attributable to correction.
1. Refer to the Sections of the Work for referenced codes, standards, tests, etc., applicable to the Work.

1.03 NOTICES

Concealed or Unknown Conditions:

- A. If the Contractor encounters conditions at the site are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature, that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 21 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any of the Work, will recommend and equitable adjustment in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor in writing, stating the reasons.
- B. If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites, or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume operations. The Contractor shall continue to suspend operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features.

1.04 PERMITS

- A. Permits, Fees, Licenses, and Inspections: Unless otherwise provided in the Contract Documents, Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, inspections and approvals by government and utility agencies, necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.
- B. Owner will obtain plan approvals and pay all fees required by the Wisconsin Department of Safety and Professional Services.
- C. Contractor shall obtain all permits and pay all fees required by local utilities for permanent electric and gas service.
- D. Contractor shall obtain copies of all required permits and certificates of inspection applicable to the work.
- E. Contractor shall furnish A/E and Owner with copy of all required permits and certificates.

PART 2 – PRODUCTS - THIS SECTION NOT USED

PART 3 – EXECUTION - THIS SECTION NOT USED

END OF SECTION

**SECTION 01 42 19
REFERENCE STANDARDS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements relating to referenced standards.
- B. Reference standards full title and edition date.

1.02 QUALITY ASSURANCE

- A. For products or workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Comply with the reference standard of date of issue specified in this section, except where a specific date is established by applicable code.
- C. Should specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.
- D. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Architect shall be altered by Contract Documents by mention or inference otherwise in any reference document.

PART 2 CONSTRUCTION INDUSTRY ORGANIZATION DOCUMENTS

2.01 AA -- ALUMINUM ASSOCIATION, INC.

2.02 AABC -- ASSOCIATED AIR BALANCE COUNCIL

2.03 AAMA -- AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

2.04 ACI -- AMERICAN CONCRETE INSTITUTE INTERNATIONAL

2.05 ACMA -- AMERICAN COMPOSITES MANUFACTURERS ASSOCIATION

2.06 AFPA -- AMERICAN FOREST AND PAPER ASSOCIATION

2.07 AGA -- AMERICAN GALVANIZERS ASSOCIATION, INC.

2.08 AGC -- ASSOCIATED GENERAL CONTRACTORS OF AMERICA

2.09 AGMA -- AMERICAN GEAR MANUFACTURERS ASSOCIATION

2.10 AHA -- AMERICAN HARDBOARD ASSOCIATION

2.11 AHRI -- AIR-CONDITIONING, HEATING, AND REFRIGERATION INSTITUTE

2.12 AI -- THE ASPHALT INSTITUTE

2.13 AIA -- THE AMERICAN INSTITUTE OF ARCHITECTS

2.14 AISC -- AMERICAN INSTITUTE OF STEEL CONSTRUCTION, INC.

2.15 AISI -- AMERICAN IRON AND STEEL INSTITUTE

2.16 ALSC -- AMERICAN LUMBER STANDARDS COMMITTEE

2.17 ANSI -- AMERICAN NATIONAL STANDARDS INSTITUTE

- A. ANSI/SDI A250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames; 2019.
- B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2022.

- C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2020.
- D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.
- E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.

2.18 APA -- APA - THE ENGINEERED WOOD ASSOCIATION

2.19 ASA -- ACOUSTICAL SOCIETY OF AMERICA

2.20 ASCE -- AMERICAN SOCIETY OF CIVIL ENGINEERS

2.21 ASHRAE -- AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC.

2.22 ASME -- THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

2.23 ASPE -- AMERICAN SOCIETY OF PLUMBING ENGINEERS

2.24 ASSE -- AMERICAN SOCIETY OF SANITARY ENGINEERING

2.25 ASTM A SERIES -- ASTM INTERNATIONAL

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- C. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023.
- D. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

2.26 ASTM B SERIES -- ASTM INTERNATIONAL

- A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

2.27 ASTM E SERIES -- ASTM INTERNATIONAL

- A. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
- B. ASTM E413 - Classification for Rating Sound Insulation; 2022.

2.28 BHMA -- BUILDERS HARDWARE MANUFACTURERS ASSOCIATION

- A. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.

2.29 BIFMA -- BUSINESS AND INSTITUTIONAL FURNITURE MANUFACTURERS ASSOCIATION

2.30 CSI/CSC -- CONSTRUCTION SPECIFICATIONS INSTITUTE/CONSTRUCTION SPECIFICATIONS CANADA

2.31 DASMA -- DOOR & ACCESS SYSTEMS MANUFACTURERS' ASSOCIATION, INTERNATIONAL

2.32 ICC -- INTERNATIONAL CODE COUNCIL, INC.

- A. ICC A117.1-2009 - Accessible and Usable Buildings and Facilities; 2009.
- B. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. ICC (IBC)-2015 - International Building Code; 2015.

2.33 IEEE -- INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS**2.34 IGMA -- INSULATING GLASS MANUFACTURERS ALLIANCE**

- A. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (Reaffirmed 2016).
- B. IGMA TM-4000 - Insulating Glass Manufacturing Quality Procedures; 2002 (Reaffirmed 2007).

2.35 MFMA -- METAL FRAMING MANUFACTURERS ASSOCIATION**2.36 NAAMM -- THE NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS**

- A. NAAMM HMMA 805 - Recommended Selection and Usage Guide for Hollow Metal Doors and Frames; 2012.
- B. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- C. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- D. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2017.
- E. NAAMM HMMA 850 - Fire-Rated Hollow Metal Doors and Frames; 2014.
- F. NAAMM HMMA 865 - Guide Specifications for Sound Control Hollow Metal Door and Frame Assemblies; 2013.

2.37 NFPA -- NATIONAL FIRE PROTECTION ASSOCIATION

- A. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- B. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.

2.38 SDI -- STEEL DOOR INSTITUTE

- A. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2023.

2.39 UL -- UNDERWRITERS LABORATORIES INC.

- A. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

END OF SECTION

**SECTION 01 43 39
MOCKUPS****PART 1 – GENERAL****1.01 SUMMARY**

- A. A. Definition
 - 1. Mockups are field samples constructed, applied, or assembled at the project site for review by the Owner, Owners Representative, Architect and Consultants.
 - 2. Mockups are three dimensional, true scale models that illustrate materials and methods, equipment, workmanship, or location; based on plans, details, and assemblies.
- B. Approved mockups establish the standard of quality by which the final work will be judged.
- C. Approved mockups shall be properly documented and entered into the Submittal Library on the Project Management Web Site like any other required submittal. See section 3.4 below for more information.

1.02 RELATED SPECIFICATIONS

- A. Section 01 26 13 - Request for Information (RFI).
- B. Section 01 26 46 - Change Bulletin (CB).
- C. Section 01 26 63 - Change Order (CO).
- D. Section 01 31 19 - Project Meetings.
- E. Section 01 32 16 - Construction Progress Schedules.
- F. Section 01 33 23 – Submittals.
- G. Section 01 45 00 - Quality Control.

1.03 RELATED DOCUMENTS

- A. The following documents shall be used for preparing mockups.
 - 1. All plans, specifications, and details including those derived as revisions (RFI, CB, CO).
 - 2. Construction Progress Schedules. Mockups shall be done and completed in a timely fashion for review and approval so as to not impact the Contractors project schedule.
 - 3. Any Manufacturers installation/assembly instructions.

1.04 PERFORMANCE REQUIREMENTS

- A. All Contractors shall be responsible for providing and constructing mockups as specified in their Division of Work in the plans and specifications.
- B. Materials to be used shall be as specified in the construction documents, full sized and properly assembled.
- C. Completed mockups shall be of sufficient size to provide visible detail of all components as needed for the sample.

1.05 QUALITY ASSURANCE

- A. The General Contractor (GC) shall be responsible for coordinating all of the following as needed:
 - 1. Designating the location for the mockup construction
 - 2. Coordinating the work of all contractors and materials required to complete the mockup
 - 3. Ensuring that the mockup meets the intent of the construction documents before scheduling the mockup review meeting.

PART 2 - PRODUCTS**2.01 MATERIALS**

- A. The materials used in mockups shall be only those materials indicated in the plans, specifications, and favorably reviewed submittals.

- B. Mockups shall be made of full scale materials as delivered to the project site.
- C. All materials associated with a particular detail, construction method, manufacturer's installation instructions shall be properly represented and visible in the mockup. This includes but is not limited to finished mortar joints, sealants, backer rods, tie bars, rebar, etc.

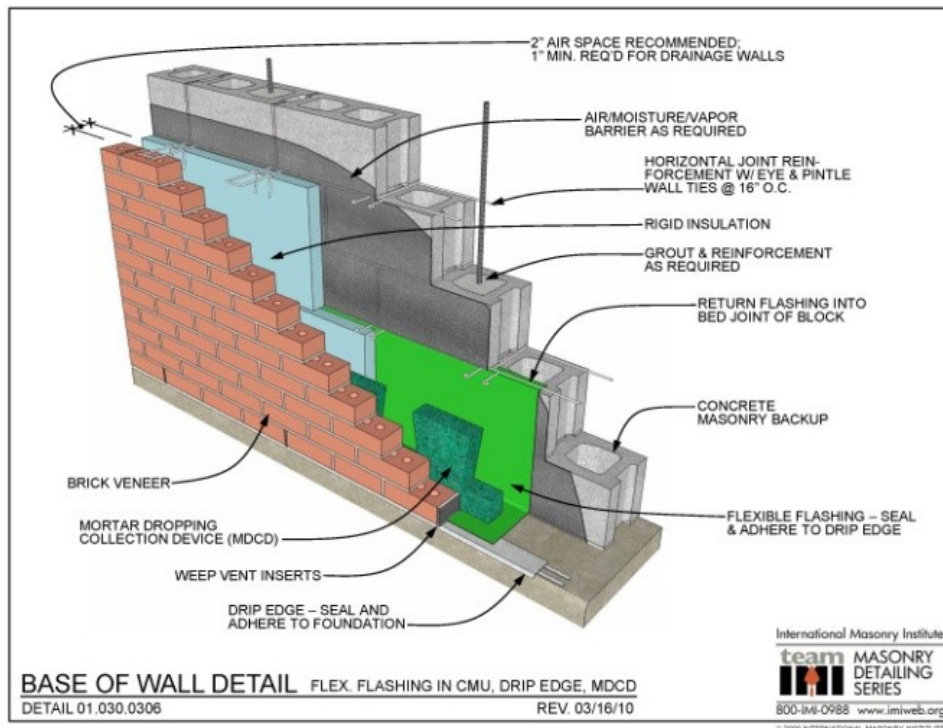
PART 3 - EXECUTION

3.01 REVIEW THE PLANS AND SPECIFICATIONS

- A. The GC shall review the plans and specifications with all required contractors prior to constructing the mockup.
 - 1. Mockups that will be built and remain in place, if favorably reviewed, will be installed in an area easily accessible for review.
 - 2. Mockups that will not be built in place or will not remain will be constructed in a space on the project site protected from weather, construction traffic, and other such disturbances until such time as the associated work has been completed.
 - 3. Insure all products being represented in the mockup meet the plans, specifications, and any published changes.

3.02 MOCKUP CONSTRUCTION

- A. Mockups shall be of sufficient size to show various material adjacencies, connectivity, patterns, and other such related features.
- B. Mockups shall be constructed in a layered fashion so that all products being used can be seen and evaluated.
- C. The construction detail below is an example of a properly layered mockup.



D. The following mockups are required:

1. Exterior Wall Assembly.

- a. Contractor shall provide (1) exterior materials mock up for each exterior cladding material for the owner's and architects review and approval prior to final ordering of scheduled materials. See exterior elevations sheets for materials schedule.
- b. Mockup size shall include a 2x4 minimum section of each exterior cladding system with a 2x2 sample window, head, jamb, sill, all back-up wall assembly, waterproofing and flashings. Mock up size shall be 4' x 4' minimum and show typical exterior material transitions of all designed exterior walls.
- c. Mockup shall be a complete and independent structure, located on site and not part of the finished construction.
- d. The project schedule shall allow time to design, construct, and obtain approvals from the owner and architect in two phases:
 - 1) PHASE 1: backup wall assembly, sheathing, air i water-resitive barrier, window, window flashings, base flashings, etc.
 - 2) PHASE 2: exterior cladding, material transitions, sealants, mortar, weeps, etc.
- e. The project schedule shall allow time to implement any changes or modifications as a result of mockup approvals.

3.03 MOCKUP REVIEW

- A. The General Contractor and all associated Sub-contractors (Contracting Team) shall meet with the Owner, Owners Representative, Architect and Consultants (Design Team) as necessary to review the mock-up. Contractors shall be prepared to answer questions on materials and methods as necessary.
- B. The Contracting and Design Teams shall review the mockup in detail for materials, methods, and workmanship with respect to the intent of the contract documents. Improvements or adjustments shall be discussed as needed.
- C. If the mockup is incomplete or does not show sufficient detail of products and workmanship the General Contractor shall resubmit a new mockup.
- D. Re-submittal of mockups to meet the intent of the contract documents shall be the responsibility of the General Contractor. No Change Orders will be processed for additional time or materials associated with re-submitting a mockup for approval.
 1. In the event that a submitted mockup meets the criteria of the contract documents but does not meet the expectations of the design team and alternative methods or materials are discussed the following procedure shall be used:
 - a. Project Architect shall publish a Construction Bulletin (CB) to detail the required/recommended changes.
 - b. The GC shall prepare and submit a new mockup.

3.04 FINAL SUBMITTAL

- A. The field approved mockup shall be submitted by the General Contractor as any other submittal for project documentation purposes. The mockup submittal shall consist of the following:
 1. Digitally photograph the field approved mockup. Take as many detailed photos as necessary to capture the complexity of the mockup.
 2. Provide a written summary of the approved mockup. Include all recommended adjustments, level of expected workmanship, and other such detail as discussed during the mockup review.
 3. Submit the mockup to the Project Management Web Site. See Specification 01 33 23 - Submittals for additional information.

END OF SECTION

**SECTION 01 43 50
AIR BARRIER SYSTEMS**

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, Division 07 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Contractor will engage a qualified consultant(s) to perform tests and inspections prior to the installation of air barrier components.
- B. This section includes administrative and procedural requirements for accomplishing an airtight building enclosure that controls infiltration or exfiltration of air.
- C. Related Sections:
 - 1. Section 07 25 00: Weather Barriers.
 - 2. Requirements of this section relate to the coordination between subcontractors required to provide an airtight building enclosure, customized fabrication and installation procedures, not production of standard products.

1.03 DEFINITIONS

- A. Air Barrier System: The airtight components of the building enclosure and the joints, junctures and transitions between materials, products, and assemblies forming the air-tightness of the building enclosure.
- B. Services: Include coordination between the trades, the proper scheduling and sequencing of the work, pre-construction meetings, inspections, tests, and related actions, including reports performed by Contractor, by independent agencies, and by governing authorities. They do not include contract enforcement activities performed by Architect.

1.04 PERFORMANCE REQUIREMENTS

- A. General Performance: The Contractor shall ensure that the intent of constructing the building enclosure with a continuous air barrier system to control air leakage into, or out of the conditioned space is achieved. The air barrier system shall have the following characteristics:
 - 1. It shall be continuous, with all joints sealed.
 - 2. It shall be structurally supported to withstand positive and negative air pressures applied to the building enclosure.
 - 3. Continuity of the air barrier materials and products with joints to provide complete assemblies.
 - 4. Continuity of all the enclosure assemblies with joints and transition materials to provide a whole building air barrier system.
- B. Connection shall be made between:
 - 1. Foundation and walls.
 - 2. Walls and windows or doors.
 - 3. Different wall systems.
 - 4. Wall and roof.
 - 5. Wall and roof over unconditioned space.
 - 6. Walls, floor and roof across construction, control and expansion joints.
 - 7. Walls, floors and roof to utility, pipe and duct penetrations.
- C. Air Barrier Penetrations: All penetrations of the air barrier and paths of air infiltration / exfiltration shall be made air-tight.

D. Compliance Requirements:

1. Assemblies: an air permeance not to exceed 0.03 cfm/ft²p under a pressure differential of 0.3 inch (7.62 mm). water (1.57psf) (0.15 L/s.m² @ 75 Pa) when tested in accordance with ASTM E 1677.
2. Materials: Materials used for the air barrier system in the opaque envelope shall have an air permeance not to exceed 0.004 cfm/ft² under a pressure differential of 0.3 inch (7.62 mm). water (1.57psf) (0.02 L/s.m² @ 75 Pa) when tested in accordance with ASTM E 2178. Or,
3. Entire Building: The air leakage of the entire building shall not exceed 0.15 cfm/sf under a pressure differential of 0.3 inch (7.62 mm). water (1.57psf) (0.75 L/s.m² @ 75 Pa) when tested according to ASTM E 779.

1.05 SUBMITTALS**A. Field quality-control reports.****B. Testing agency shall submit a certified written report, in duplicate, of each inspection, test, or similar service to the Architect. If the Contractor is responsible for the service, submit a certified written report, in duplicate, of each inspection, test, or similar service through the Contractor.**

1. Submit additional copies of each written report directly to the governing authority, when the authority so directs.

C. Report Data: Written reports of each inspection, test, or similar service include, but are not limited to, the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making the inspection or test.
6. Designation of the Work and test method.
7. Identification of product and Specification Section.
8. Complete inspection or test data.
9. Test results and an interpretation of test results.
10. Ambient conditions at the time of sample taking and testing.
11. Comments or professional opinion on whether inspected or tested Work complies with Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting.

1.06 QUALITY ASSURANCE**A. General Performance: The Contractor shall ensure that the intent of constructing the building enclosure with a continuous air barrier system to control air leakage into, or out of the conditioned space is achieved. The air barrier system shall have the following characteristics:****B. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with Contract Document requirements.**

1. Qualifications for Air Barrier Testing and Inspection Agencies: Engage Air Barrier inspection and testing service agencies, including independent testing laboratories, that are prequalified and that specialize in the types of air barrier system inspections and tests to be performed.

C. Specific quality-control requirements for individual construction activities are specified in the sections of the specifications. Requirements in those sections may also cover production of standard products. It is the Contractor's responsibility to ensure that each subcontractor is adequately and satisfactorily performing the quality assurance documentation, tests and procedures required by each section.**D. Specified inspections, tests, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with Contract Document requirements.**

1.07 PROJECT CONDITIONS

- A. Contractor Responsibilities: Unless otherwise indicated as the responsibility of another identified entity, Contractor shall provide coordination of the trades, and the sequence of construction to ensure continuity of the air barrier system joints, junctures and transitions between materials and assemblies of materials and products, from substructure to walls to roof. Provide quality assurance procedures, testing and verification as specified herein. Facilitate inspections, tests, and other quality-control services specified elsewhere in the Contract Documents and required by authorities having jurisdiction or by the Owner. Costs for these services are included in the Contract Sum.
- B. Organize preconstruction meetings between the trades involved in the whole building's air barrier system to discuss where each trade begins and ends and the responsibility and sequence of installation of all the air-tight joints, junctures, and transitions between materials, products and assemblies of products specified in the different sections, to be installed by the different trades.
- C. Build a mock-up before proceeding with the work, satisfactory to the Architect, of each airtight joint type, juncture, and transition between products, materials and assemblies.
- D. Associated Services: Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include, but are not limited to, the following:
 - 1. Provide access to the Work.
 - 2. Furnish incidental labor and facilities necessary to facilitate inspections and tests.
 - 3. Take adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.
 - 4. Deliver samples to testing laboratories.
 - 5. Provide security and protection of samples and test equipment at the Project Site.
- E. Duties of the Testing and Inspection Agency: The independent agency engaged to perform inspections, sampling, and testing of air barrier materials, components and assemblies specified in individual Sections shall cooperate with the Architect and the Contractor in performance of the agency's duties. The testing agency shall provide qualified personnel to perform required inspections and tests.
 - 1. The agency shall notify the Architect and the Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. The agency is not authorized to release, revoke, alter, or enlarge requirements of the Contract Documents or approve or accept any portion of the Work.
 - 3. The agency shall not perform any duties of the Contractor.
- F. Coordination: Coordinate the sequence of activities to accommodate required services with a minimum of delay. Coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.
 - 1. The Contractor is responsible for scheduling times for inspections, tests, taking samples, and similar activities.

PART 2 – PRODUCTS – NOT USED

PART 3 - EXECUTION**3.01 FIELD QUALITY CONTROL**

- A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 - 1. Qualitative Testing and Inspection:
 - a. Daily reports of observations, with copies to the Owner, Contractor and Architect.
 - b. Continuity of the air barrier system throughout the building enclosure with no gaps, holes.
 - c. Structural support of the air barrier system to withstand design air pressures.
 - d. Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions and mortar droppings, with mortar joints struck flush, or as required by the manufacturer of the air barrier material.
 - e. Site conditions for application temperature and dryness of substrates.
 - f. Maximum length of exposure time of materials to ultra-violet deterioration.
 - g. Surfaces are properly primed.
 - h. Laps in material are 2" minimum, shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.
 - i. Mastic applied on cut edges.
 - j. Roller has been used to enhance adhesion.
 - k. Measure application thickness of liquid-applied materials to manufacturer's specifications for the specific substrate.
 - l. Materials used for compatibility.
 - m. Transitions at changes in direction, and structural support at gaps.
 - n. Connections between assemblies (membrane and sealants) for cleaning, preparation and priming of surfaces, structural support, integrity and continuity of seal.
 - o. All penetrations sealed.
 - 2. Testing Standards
 - a. Refer to Specification Sections 01-91-19 Building Enclosure Commissioning Requirements

3.02 REPAIR AND PROTECTION

- A. Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes. Comply with Contract Document requirements for Division 1 Section "Cutting and Patching."
- B. Protect construction exposed by or for quality-control service activities and protect repaired construction.
- C. C. Repair and protection is Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.

END OF SECTION

- I. Bond to substrate, ASTM D4541-95.
- m. Minimum dry or wet film thickness for liquid-applied materials are per the manufacturer's requirements.

3.02 REPAIR AND PROTECTION

- A. Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes. Comply with Contract Document requirements for Division 1 Section "Cutting and Patching."
- B. Protect construction exposed by or for quality-control service activities, and protect repaired construction.
- C. Repair and protection is Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.

END OF SECTION

SECTION 01 45 16
FIELD QUALITY CONTROL PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

- A. The City of Madison (CoM) has developed a multi-faceted Quality Management Program that begins with contract signing and runs through contract closeout to ensure the best quality materials, workmanship, and product are delivered for the contracted Work.
 - 1. The Project Management Web Site (PMWS) is a Construction Management tool that provides contractors and staff a single on-line location for the daily operations and progression of the Work.
 - 2. The Quality Management Observation (QMO) is an ongoing observation of the construction process as it progresses. The City of Madison does not use a "Punch List" or "Corrections List" as it is typically known throughout the construction industry. The QMO process acts as an "in progress punch list".
 - a. By using the QMO process the City of Madison's goal is to have a zero item punch list prior to the 90% progress payment and owner occupancy.
- B. All contractors shall be required to review the specifications identified in Section 1.02 below, and other related specifications identified therein to become familiar with the terminology and expectations of this City of Madison Public Works contract.
- C. It is the intent of this specification to outline the requirements, expectations, and responsibilities of the General Contractor (GC), Project Architect (PA or A/E/PROJ MGR), and other representatives of the Owner for items of Quality Assurance and Quality Control.
 - 1. This specification is not intended to conflict with Specification 01 40 00 - Quality Requirements or other specifications requiring testing and inspecting services.
 - 2. This specification does not relieve the GC from any requirements associated with regulatory inspections performed by the City of Madison Building Inspection Unit, or inspectors from other agencies as required by code.
 - 3. Any testing performed by an Owner's Representative does not relieve the GC from performing any testing that may be required by the construction documents.

1.02 RELATED SPECIFICATION SECTIONS

- A. Section 01 26 13 - Request for Information (RFI).
- B. Section 01 29 76 - Progress Payment Procedures.
- C. Section 01 31 13 - Project Coordination.
- D. Section 01 31 23 - Project Management Web Site (PMWS).
- E. Section 01 40 00 - Quality Requirements.
- F. Section 01 77 00 - Closeout Procedures.
- G. Section 01 78 13 - Completion and Correction List.
- H. Section 01 91 00 - Commissioning.

1.03 PERFORMANCE REQUIREMENTS

- A. All contractors shall be responsible for a proper quality assurance/quality control (QA/QC) program throughout the execution of the Work defined within the construction documents, including all recognized construction industry standards and all applicable regulatory codes.
- B. The GC shall be responsible for all of the following:
 - 1. Monitor the quality of all workmanship, supplies, materials, and products being installed by all contractors and installers to ensure they meet or exceed the minimum requirements set forth by the construction documents.

2. Submit a Request for Information (RFI) whenever manufacturers' instructions or referenced standards conflict with the construction documents before proceeding with the Work.
3. Ensure that Work requiring special certifications or licensing is being performed by is being performed and supervised by personnel that meet the appropriate requirements.
 - a. Ensure that all certificates and licenses are current throughout the execution of the project.
- C. The CoM and its representatives shall perform quality assurance and quality control activities throughout the execution of this project. This in no way relieves the GC of maintaining an acceptable QA/QC program.

1.04 QUALITY ASSURANCE

- A. The GC shall be responsible for the following:
 1. All materials, equipment, and products shall be new, clean, undamaged, and meet the performance specifications defined within the construction documents including favorably reviewed submittals.
 - a. Any material, equipment, or product that does not meet the requirements of the construction documents shall be removed and replaced, including any adjacent and related work, at the GCs expense.
 2. All Work shall be performed by persons properly trained and/or qualified to produce workmanship of the quality specified in the construction documents.
 3. Providing access to updated as-builts, addenda, submittals, bulletins and other related construction documents at the project site.
- B. The CoM and its representatives may be responsible for any of the following:
 1. Attend pre-installation meetings.
 2. Attend construction progress meetings.
 3. Review all submittals.
 4. Conduct field visits for QA/QC purposes, provide feedback to the GC and sub-contractors using Quality Management Observation (QMO) reports.
 5. Review delivered equipment.
 6. Witness equipment installations, startups, testing as specified in other specifications.

1.05 QUALITY MANAGEMENT OBSERVATION REPORT

- A. The Quality Management Observation report or QMO is used as a QA/QC tool by those entities responsible for QA/QC activities, including but not limited to, the GC, CoM, Project Architect /Project Engineer(A/E PROJ MGR), Cx Agent, etc.
- B. QMOs are designed to be an early observation of non-conforming construction work before it becomes buried by follow on work. As such it is most often used as an "in progress punch list".
- C. QMO forms are part of the Quality Control Library on the Project Management Web Site (PMWS).

PART 2 – PRODUCTS - THIS SECTION NOT USED

PART 3 - EXECUTION

3.01 QUALITY MANAGEMENT RESPONSIBILITIES

- A. While making routine progress visits to the construction project the GC, CPM, CxA and A/E PROJ MGR, and applicable others shall observe the details of the construction and installations to ensure that the intent of the construction documents is being followed.
- B. If during the progress visit there is a determination of contract non-conformance a QMO report shall be initiated to begin the documentation process.
 1. The GC field superintendent shall be informed immediately of any issue that may cause harm, damage to finished work, or be buried prior to properly filing a QMO report.
- C. The following information when filing a QMO report:
 1. Open a QMO report in the Project Management Web Site.
 2. Enter the date and time of the field visit.

3. Provide references to construction documents if any (examples; specification, drawing page, details, approved submittals, RFI, CB, etc).
 4. Provide a short title for the observation being made.
 5. Provide a detailed description of the observation being made.
 6. Select all categories (Sitework, Structure, Enclosure, Interior, etc) from the given list that may apply to the observation being reported.
 - a. For each category selected additional boxes shall open with contractor names associated with each category.
 7. Select all contractors from the lists provided that may need to be aware of the observation.
 8. Provide any attachments that may help provide reference to the observation.
- D. The software for the Project Management Website will email notifications that a QMO report has been initiated.

3.02 RESPONDING TO A QMO

- A. The GC shall be responsible for determining the course of action required to remedy the non-conforming issue and shall coordinate and direct the contractor(s) responsible for any work related to the observation.
- B. All contractors assigned to remedy the observation by the GC shall provide follow-up responses.
 1. Open the QMO report in the Project Management Web Site.
 2. Enter a description of your follow-up response in the box provided.
 3. Add attachments (pictures) if needed to show the work has been completed.

3.03 GENERAL CONTRACTORS FOLLOW-UP

- A. The GC shall inspect the work to ensure that all assigned contractors have remedied the observation to the intent of the construction documents.
- B. The GC shall respond with any additional comments in their response box.

3.04 QMO CLOSEOUT PROCEDURE

- A. The person who initiated the QMO shall review the remedied work and if properly corrected shall close and date the QMO form.
 1. In the event there are still issues the Quality Manager can add additional comments in the response area, and re-issue the QMO for additional review as needed.
- B. Once the person who initiated the QMO has closed the item the CPM shall review and verify with the A/E PROJ MGR that the Observation has been properly remedied and provide final closure on the QMO.

3.05 CONSTRUCTION CLOSEOUT

- A. The GC shall note that successful close out QMOs are required for construction closeout as follows:
 1. Certain progress payments as identified in Specification 01 29 76 are contingent QMO reports being properly closed out.
 2. Specification 01 77 00 defines all construction closeout requirements.

END OF SECTION

SECTION 01 45 29
TESTING LABORATORY SERVICES

PART 1 – GENERAL

1.01 REQUIREMENTS INCLUDED

- A. The Contractor shall employ and pay for the services of an independent testing laboratory to perform specified services and testing.
- B. Testing Laboratory inspection, sampling and testing is required for:
 - 1. Section 03 30 00: Cast-In-Place Concrete.
 - 2. Section 05 12 00: Steel Joist Framing.
 - 3. Section 05 40 00: Cold-Formed Steel Framing.
 - 4. Division 31: Earthwork.

1.02 RELATED REQUIREMENTS

- A. Conditions of the Contract: Inspections and testing required by laws, ordinances, rules, regulations, orders or approvals of public authorities.
- B. Related Requirements Specified in Other Sections:
 - 1. Division 22 and 23: Testing of Mechanical Systems
 - 2. Division 26: Testing of Electrical Systems

1.03 QUALIFICATION OF LABORATORY

- A. Meet "Recommended Requirements of Independent Laboratory Qualification" published by American Council of Independent Laboratories.
- B. Meet basic requirements of ASTM E 329, "Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction."
- C. Authorized to operate in State in which the Project is located.

1.04 LABORATORY DUTIES

- A. Cooperate with Owner, A/E and Contractor; provide qualified personnel after due notice.
- B. Perform specified inspections, sampling and testing of materials and methods of construction:
 - 1. Comply with specified standards.
 - 2. Ascertain compliance of materials with requirements of Contract Documents.
- C. Promptly notify the Owner, A/E and Contractor of observed irregularities or deficiencies of work or products.
- D. Promptly submit written report of each test and inspection; one copy each to A/E, Consulting Engineer, Owner and Contractor. Each report shall include:
 - 1. Date issued.
 - 2. Project Title and number.
 - 3. Testing laboratory name, address and telephone number.
 - 4. Name and signature of laboratory inspector.
 - 5. Date and time of sampling or inspection.
 - 6. Record of temperature and weather conditions.
 - 7. Date of test.
 - 8. Identification of product and specification section.
 - 9. Location of sample or test in the Project.
 - 10. Type of inspection or test.
 - 11. Results of tests and compliance with Contract Documents.
 - 12. Interpretation of test results, when requested by A/E or the Contractor.
- E. Perform additional tests as required by Owner, A/E or the Contractor.

1.05 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

- A. Laboratory is not authorized to:
 - 1. Release, revoke, alter, or enlarge on requirements of Contract Documents.
 - 2. Approve or accept any portions of the Work other than those portions of the Work scheduled for testing.
 - 3. Perform any duties of the Contractor.

1.06 CONTRACTOR'S RESPONSIBILITIES

- A. Cooperate with laboratory personnel, provide access to Work and to manufacturer's operations.
- B. Secure and deliver to the laboratory, adequate quantities of representative samples of materials proposed to be used and which require testing. Submit concrete mix designs to A/E for approval prior to pouring concrete.
- C. Provide to the laboratory the preliminary design mix proposed to be used for concrete, and other material mixes that require control by the testing laboratory.
- D. Furnish copies of Product test reports as required.
- E. Furnish incidental labor and facilities:
 - 1. To provide access to Work to be tested.
 - 2. To obtain and handle samples at the Project site or at the source of the product to be tested.
 - 3. To facilitate inspections and tests.
 - 4. For storage and curing of test samples.
- F. Notify laboratory sufficiently in advance of operations to allow for laboratory assignment of personnel and scheduling of tests.
- G. Make arrangements with laboratory and pay for additional samples and tests required for Contractor's convenience.
- H. Employ and pay for the services of a separate, equally qualified independent testing laboratory to perform additional inspections, sampling and testing required when initial tests indicate work does not comply with Contract Documents.
- I. Temporarily halt the progress of the Work when tested materials do not comply with Contract Documents and promptly notify the Owner or their designated representative and A/E.
- J. Remove and replace at no cost to the Owner, all defective materials discovered upon testing not to comply with Contract Documents, including cost for retesting and re-inspecting replaced Work that failed to comply with the Contract Documents.

1.07 SPECIFIC TEST, INSPECTIONS, AND METHODS REQUIRED

- A. Section 03 30 00 - Cast-In-Place Concrete:
 - 1. Secure sample of aggregates Contractor proposes to use and test for compliance with Specifications.
 - 2. Certify compliance with Specifications of cement proposed for use by the Contractor.
 - 3. Review and approve the Contractor's proposed concrete mix proportions for the required concrete strengths using materials Contractor proposed to use on the project. Incorporate specified admixtures and not less than amounts of cement specified.
 - 4. Perform appropriate laboratory tests, including compression tests of cylinders and slump test to substantiate mix designs.
 - 5. Inspect and test materials during concrete work to substantiate compliance with Specifications and mix requirements.
 - a. Testing:
 - 1) Sample and test concrete in accordance with ASTM C 31, ASTM C 143, ASTM C 172, and ASTM C 231.
 - 2) Perform slump tests in accord with ASTM C 143 from same concrete batch used for test cylinders and record results and comments on compression test reports.

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- 3) Perform compression tests in accordance with ASTM C39.
 - 4) When air-entrained concrete is used, a minimum of one (1) air content test shall be performed in accordance with ASTM C 231 for each set of test cylinders taken.
 - 5) Identify all test cylinders with symbols to indicate location on the job where concrete test was made. Record on project record drawings.
 - 6) Strength tests shall be made for: each day's pour; each class of concrete; each change of supplies or sources; and for each 100 cubic yards of concrete or fraction thereof.
 - 7) One slump test shall be made for each set of test cylinders taken following the procedure in ASTM C 143.
- b. Test Cylinders for all Concrete
- 1) Each test shall consist of a minimum of four cylinders.
 - 2) Make test cylinders in conformity with ASTM C 31.
 - 3) After 24 hours three cylinders to be carefully transported to the testing laboratory for moisture curing and one cylinder to be field cured.
 - 4) One field cured cylinder to be tested at 7 days and two laboratory cured cylinders to be tested at 28 days. Reserve one cylinder for further testing.
 - 5) The average of all strength tests representing each class of concrete, as well as the average of any three consecutive strength tests for each class of concrete, shall be equal to or greater than the specified strength.
 - 6) If the A/E has reason to believe that cylinder strength tests are not representative of the strength of concrete in place, A/E shall require drilled cores to be cut and tested at the Contractor's expense. Coring and testing shall be in accordance with ASTM C 42 Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- B. Section 05 12 00 - Steel Joist Framing:
1. Welding:
 - a. Provide inspection of shop and field welding in accordance with Section 6 of AWS D1.1.
 - b. Visually inspect all welds, perform appropriate non-destructive tests on apparent defective welds. Verify conformance with Specifications.
 - c. Non-destructive testing shall be performed on 20 percent of the total length of all full penetration welds. If a sufficient number of welds are deficient, additional testing may be performed at the discretion of the testing lab, at no cost to Owner.
 2. Bolting:
 - a. Visually inspect all connections for proper number, size and type of bolt.
 - b. Review all bolted connections for compliance with "snug tight" requirements of AISC.
 - c. No Slip-critical (SC) connections/bolts are required for this project.
 - d. Shear Connectors, Headed/Deformed Bar Concrete Anchors:
 - 1) Verify pre-production test records for installation of shear connectors, concrete anchors and threaded studs.
 - 2) Shear connectors shall be struck with a hammer. Those not producing a "clean" pinging sound indicative of a fully attached shear connector shall be bent 15 degrees off vertical towards the nearest support by striking with a hammer. If shear connector does not become loose and weld is not broken, it shall be considered acceptable, and shall be left in the bent position. Replace failing shear connectors and test as before.
 - 3) A visual inspection shall be made of shear connectors and headed/deformed bar concrete anchors after installation. If visual inspection reveals that a sound weld and a 360 degree flash has not been obtained, the connector/anchor shall also be tested by bending a minimum of 15 degrees off vertical opposite to the missing weld/flash, irrespective of the results of the "ping" test required for shear connectors. If the connector/anchor does not become loose it shall be considered acceptable and shall be left in this position. Replace failing connector/anchors and inspect as before.
- C. Section 05 40 00 - Cold Formed Steel Framing:
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1. As directed by A/E, Contractor's testing agency may inspect the maintenance of a quality control program including spot checking weldments and welding procedures in accordance with AWS standards.

D. DIVISION 31 - Earthwork:

Soil Compaction Control and Trenching and Backfilling

1. Soils Engineer to be onsite during excavation operation.
2. Visually inspect, test, and certify that exposed undisturbed underlying soil is suitable for required footing bearing capacity and placement of fills.
3. Maximum and minimum density of fill soil for compaction percentage of relative density and moisture density shall be determined in accordance with ASTM Designation D 1557. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable.
4. Number of tests as follows:
 - a. Subgrade, Undisturbed and Demolition Surfaces: Visual inspection and probe; test if required.
 - b. Interior Fills: One test per 2,500 sq. ft for each two foot or less lift.
 - c. Exterior Fills: One test per 2,500 sq. ft for each two foot or less lift.
 - d. Utility Trenches: One test per 50 lineal feet for each two foot or less lift.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 – EXECUTION – THIS SECTION NOT USED

END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 – GENERAL

1.01 REFERENCE STANDARDS

- A. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).

1.02 SUMMARY

- A. This Section includes general procedural requirements for temporary facilities and controls including, but not limited to the following:
 - 1. Temporary Utilities.
 - 2. Telecommunications Services.
 - 3. Temporary Sanitary Facilities.
 - 4. Barriers.
 - 5. Fencing.
 - 6. Exterior Enclosures.
 - 7. Security.
 - 8. Vehicular Access and Parking.
 - 9. Waste Removal.
 - 10. Project Identification.
 - 11. Field Offices.

1.03 RELATED SPECIFICATION SECTIONS

- A. Section 01 31 19 - Progress Meetings.
- B. Section 01 31 23 - Project Management Web Site.
- C. Section 01 74 19 - Construction Waste Management and Disposal.

1.04 QUALITY ASSURANCE

- A. Regulations: Comply with industry standards and applicable laws and regulations if authorities having jurisdiction, including but not limited to:
 - 1. Building Code requirements.
 - 2. Health and safety regulations.
 - 3. Utility company regulations.
 - 4. Police, Fire Department and Rescue Squad rules.
 - 5. Environmental protection regulations.
 - 6. Joint Commission - Hospital Accreditation Standards.
- B. Standards: Comply with NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations," ANSI A10 Series standards for "Safety Requirements for Construction and Demolition," and NECA Electrical Design Library "Temporary Electrical Facilities".
- C. Electrical Service: Comply with NEMA, NECA, and UL standards and regulations for temporary electric service. Install service in compliance with NFPA 70 "National Electric Code".

1.05 TEMPORARY UTILITIES

- A. Contractor will provide the following:
 - 1. Electrical power and metering, consisting of existing facilities.
 - 2. Water supply, consisting of existing facilities.
 - 3. Contractor is required to change service, bill, and pay for all usage costs.
-

- B. General:
 - 1. Existing facilities may be used.
 - 2. New permanent facilities may be used.
- C. Temporary Water Service: Plumbing Contractor shall extend temporary water from existing building services.
 - 1. Use trigger-operated nozzles for water hoses, to avoid waste of water.
- D. Temporary Electric Power Service: Electrical Contractor shall extend temporary power from existing building services.
- E. Temporary Lighting: Electrical Contractor shall provide temporary lighting with local switching
 - 1. Install and operate temporary lighting, minimum of 30 fc, to fulfill security and protection requirements, without operating the entire system, and will provide adequate illumination for all areas of work, including construction operations and traffic conditions.
- F. Temporary Heat: General Contractor shall provide temporary heat required by construction activities, for curing or drying of completed installations or protection of installed construction from adverse effects of low temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition required and minimize consumption of energy.
 - 1. Heating Facilities: Except where use of the permanent system is authorized, provide vented self-contained LP gas or fuel oil heaters with individual space thermostatic control.
 - a. Use of gasoline-burning space heaters, open flame, or salamander type heating units is prohibited.

1.06 TELECOMMUNICATIONS SERVICES AND WI-FI

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization through construction closeout.
- B. Telecommunications services shall include:
 - 1. Windows-based personal computer dedicated to project telecommunications.
 - 2. Shared access to the internet via WIFI or similar wireless connection.
 - a. Access must be capable to support minimum of (10) wireless devices.
 - 3. Email Account/address dedicated for GC Project Manager of GC Supervisor on site.

1.07 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. Temporary toilets: Comply with regulations and health codes for the type, number, location, operation, and maintenance of fixtures and facilities. Install where facilities will best serve the Project's needs.
 - 1. Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Provide covered waste containers for used material.
 - 2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy.
- C. Maintain daily in clean and sanitary condition.
- D. Water: Provide potable water approved by local health authorities.

1.08 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 and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

1.09 FENCING

- A. Construction: Refer to Plan Documents and Specification Section 01 76 00 - Protecting Installed Construction for fencing materials and barricades.

1.10 EXTERIOR ENCLOSURES

- A. Provide temporary weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.11 SECURITY

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

1.12 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. Existing parking areas located within Extents of Construction noted in Construction Documents may be used for construction parking until IMAGINATION CENTER AT REINDAHL PARK is occupied by Owner.

1.13 WASTE REMOVAL

- A. See Section 01 74 19 - Waste Management, for additional requirements.
- B. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- C. Provide containers with lids. Remove trash from site periodically.
- D. 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.
- E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.14 PROJECT IDENTIFICATION

- A. Provide project identification sign of design and construction indicated in Section 01 58 13.
- B. Erect on site at location determined by Owner .
- C. No other signs are allowed without Owner permission except those required by law.

1.15 FIELD OFFICES

- A. Office: Weather tight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack and drawing display table.
- B. Field Office shall be located within Extents of Construction noted in Construction Documents.
- C. Provide space for Project Meetings with table and chairs to accommodate a minimum of fifteen (15) persons.
- D. Provide a minimum of a 40" LCD monitor or other digital projection device to be connected to the computer identified in Section 1.4 Telecommunications Services (above), for use during progress meetings in connection with reviewing construction progress information posted to the Project Management Web Site (Specification 01 31 23) hosted by the Owner.

PART 2 - PRODUCTS**2.01 TEMPORARY PARTITIONS**

- A. Provide dustproof partitions to limit dust and dirt migration and to separate occupied areas from fumes and noise.
 - 1. Non-fire rated partitions, standard.
-

- a. Wood stud framing, 6-mil polyethylene.

2.02 EQUIPMENT

- A. Temporary Lifts and Hoists: Contractors requiring temporary lifts and hoists shall provide facilities for hoisting materials and employees.
- B. Electrical Outlets: Electrical Contractor shall provide properly configured NEMA polarized outlets to prevent insertion of 110-120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button and pilot light, for connection of power tools and equipment.
- C. Electrical Power Cords: Contractors requiring power cords shall provide grounded extension cords; use "hard-service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords, if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
- D. Lamps and Light Fixtures: Electrical Contractor shall provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered glass enclosures, where exposed to breakage. Provide exterior fixtures where exposed to moisture.
- E. Heating Units: General Contractor shall provide temporary heating units that have been tested and labeled by UL, FM or another recognized trade association related to the type of fuel being consumed.
- F. First Aid Supplies: General Contractor shall provide first aid supplies complying with governing regulations.
- G. Fire Extinguishers: General Contractor shall provide hand-carried, portable UL-rated, fire extinguishers of NFPA recommended classes for the exposures, extinguishing agent and size required by location and class of fire exposure.

PART 3 - EXECUTION

3.01 TEMPORARY FIRE PROTECTION

- A. Until fire protection needs are supplied by permanent facilities, General Contractor shall install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses.
- B. Comply with NFPA 10 "Standard for Portable Fire Extinguishers," and NFPA 241 "Standard for Safeguarding Construction, Alterations and Demolition Operations".
- C. Locate fire extinguishers where convenient and effective for their intended purpose.
- D. Store combustible materials in containers in fire-safe locations.
- E. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways and other access routes for fighting fires.
- F. Prohibit smoking on the premises.
- G. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
- H. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site
- I. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.02 COLLECTION AND DISPOSAL OF WASTE

- A. Collect waste from construction areas and elsewhere daily
- B. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly.
- C. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to rise above 80 degrees Fahrenheit (26.67 degrees Celsius).

- D. Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material in a lawful manner.

3.03 ENVIRONMENTAL PROTECTION

- A. Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result.
- B. Avoid use of tools and equipment which produce harmful noise.
- C. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the site.

3.04 REMOVAL OF TEMPORARY UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, and materials prior to Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet (60.96 cm). Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore existing facilities used during construction to original condition.
- E. Restore new permanent facilities used during construction to specified condition.

END OF SECTION

SECTION 01 57 13
TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Prevention of erosion due to construction activities.
- B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
- C. Restoration of areas eroded due to insufficient preventive measures.
- D. Performance bond.
- E. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete for temporary and permanent erosion control structures indicated on drawings.
- B. Section 31 10 00 - Site Clearing: Limits on clearing; disposition of vegetative clearing debris.
- C. Section 31 22 00 - Grading: Temporary and permanent grade changes for erosion control.
- D. Section 31 37 00 - Riprap: Temporary and permanent stabilization using riprap.
- E. Section 32 11 23 - Aggregate Base Courses: Temporary and permanent roadways.
- F. Section 32 92 23 - Sodding: Permanent turf for erosion control.
- G. Section 32 93 00 - Plants: Permanent plantings for erosion control.

1.03 REFERENCE STANDARDS

- A. Industry Standards:
- B. ASTM D4355/D4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus 2014 (Reapproved 2018).
- C. ASTM D4491/D4491M - Standard Test Methods for Water Permeability of Geotextiles by Permittivity 2020.
- D. ASTM D4533/D4533M - Standard Test Method for Trapezoid Tearing Strength of Geotextiles 2015 (Reapproved 2023).
- E. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles 2015a.
- F. ASTM D4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile 2020b.
- G. ASTM D4873/D4873M - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples 2017 (Reapproved 2021).
- H. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit Current Edition.
- I. State Agency Authority Having Jurisdiction Standards:
 - 1. State of Wisconsin Department of Natural Resources (WDNR).
- J. Local Agency Authority Having Jurisdiction Standards:
 - 1. City of Madison Storm Water and Erosion Control Ordinance Chapter 37, Article 210.
 - 2. Standard Specifications for Public Works Construction, latest edition, Part II, Article 210
 - 3. <https://www.cityofmadison.com/engineering/developers-contractors/standard-specifications>

1.04 PERFORMANCE REQUIREMENTS

- A. Comply with requirements of EPA (NPDES) for erosion and sedimentation control, as specified by the NPDES, for Phases I and II, and in compliance with requirements of Construction General Permit (CGP), whether the project is required by law to comply or not.
 - B. Also comply with all more stringent requirements of State of WI Erosion and Sedimentation Control Manual and City of Madison Chapter 37 Stormwater and Erosion Control Ordinance, Article 210 - Erosion Control.
 - C. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.
 - D. Refer to drawings for specific notes and guidance on erosion control measures during construction to meet state and local requirements of authority having jurisdiction (AHJ).
 - E. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
 - 1. Owner will withhold payment to Contractor equivalent to all fines resulting from non-compliance with applicable regulations.
 - F. Provide to Owner a Performance Bond covering erosion and sedimentation preventive measures only, in an amount equal to 100 percent of the cost of erosion and sedimentation control work.
 - G. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.
 - H. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
 - 1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
 - 2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.
 - I. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
 - 1. Control movement of sediment and soil from temporary stockpiles of soil.
 - 2. Prevent development of ruts due to equipment and vehicular traffic.
 - 3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
 - J. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
 - 1. Prevent windblown soil from leaving the project site.
 - 2. Prevent tracking of mud onto public roads outside site.
 - 3. Prevent mud and sediment from flowing onto sidewalks and pavements.
 - 4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
 - 5. Tracking of foreign materials (mud, silt, etc.) on street and/or other paved surfaces shall be controlled during the working day as necessary and/or as directed by the Construction Engineer, but no later than the end of the working day, by one or more of the following methods:
 - a. Hand shoveling material off street or pavement surfaces.
 - b. Machine removal (such as with endloader or grader), provided that the results are equal to that of hand shoveling.
 - c. Mechanical sweeping of material off paved surfaces and adjacent streets.
 - K. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
-

1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
- L. Open Water: Prevent standing water that could become stagnant.
- M. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- C. Erosion and Sedimentation Control Plan:
 1. Submit not less than 30 days prior to anticipated start of clearing, grading, or other work involving disturbance of ground surface cover.
 2. Include:
 - a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
 - b. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.
 - c. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
 - d. Schedule of temporary preventive measures, in relation to ground disturbing activities.
 - e. Other information required by law.
 - f. Format required by law is acceptable, provided any additional information specified is also included.
 3. Obtain the approval of the Plan by authorities having jurisdiction.
 4. Obtain the approval of the Plan by Owner.
- D. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.
- E. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.
- F. Maintenance Instructions: Provide instructions covering inspection and maintenance for temporary measures that must remain after Substantial Completion.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Comply with the details on the drawings.
- B. Mulch: Use one of the following:
 1. Straw or hay.
 2. Wood waste, chips, or bark.
 3. Erosion control matting or netting.
- C. Grass Seed For Temporary Cover: Select a species appropriate to climate, planting season, and intended purpose. If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.
- D. Bales: Air dry, rectangular straw bales.
 1. Cross Section: 14 by 18 inches, minimum.
 2. Bindings: Wire or string, around long dimension.
- E. Bale Stakes: One of the following, minimum 3 feet long:
 1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot.

2. Wood, 2 by 2 inches in cross section.
- F. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
 1. Average Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
 2. Permittivity: 0.05 sec^{-1} , minimum, when tested in accordance with ASTM D4491/D4491M.
 3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355/D4355M after 500 hours exposure.
 4. Tensile Strength: 100 pounds-force, minimum, in cross-machine direction; 124 pounds-force, minimum, in machine direction; when tested in accordance with ASTM D4632/D4632M.
 5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D4632/D4632M.
 6. Tear Strength: 55 pounds-force, minimum, when tested in accordance with ASTM D4533/D4533M.
 7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.
- G. Silt Fence Posts: One of the following, minimum 5 feet long:
 1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot.
 2. Hardwood, 2 by 2 inches in cross section.
- H. Gravel: See Section 32 11 23 for aggregate.
- I. Riprap: See Section 31 37 00.
- J. Concrete: See Section 03 30 00.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.02 PREPARATION

- A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.03 SCOPE OF PREVENTIVE MEASURES

- A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.
- B. Comply with the Drawings.
- C. Construction Entrances: Traffic-bearing aggregate surface.
 1. Width: As required; 20 feet, minimum.
 2. Length: 50 feet, minimum.
 3. Provide at each construction entrance from public right-of-way.
 4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.
- D. Linear Sediment Barriers: Made of silt fences.
 1. Provide linear sediment barriers:
 - a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
 - b. Along the top of the slope or top bank of drainage channels and swales that traverse disturbed areas.
 - c. Along the toe of cut slopes and fill slopes.
 - d. Perpendicular to flow across the bottom of existing and new drainage channels and swales that traverse disturbed areas or carry runoff from disturbed areas; space at maximum of 200 feet apart.

- e. Across the entrances to culverts that receive runoff from disturbed areas.
- 2. Space sediment barriers with the following maximum slope length upslope from barrier:
 - a. Slope of Less Than 2 Percent: 100 feet..
 - b. Slope Between 2 and 5 Percent: 75 feet.
 - c. Slope Between 5 and 10 Percent: 50 feet.
 - d. Slope Between 10 and 20 Percent: 25 feet.
 - e. Slope Over 20 Percent: 15 feet.
- E. Storm Drain Curb Inlet Sediment Trap: Per Protect each curb inlet using rigid frame inlet protection.
- F. Soil Stockpiles: Protect using one of the following measures:
 - 1. Cover with polyethylene film, secured by placing soil on outer edges.
 - 2. Cover with mulch at least 4 inches thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches of straw or hay.
- G. Mulching: Use only for areas that may be subjected to erosion for less than 6 months.
 - 1. Wood Waste: Use only on slopes 3:1 or flatter; no anchoring required.
- H. Temporary Seeding: Use where temporary vegetated cover is required.

3.04 INSTALLATION

- A. Comply with the Drawings.
- B. Traffic-Bearing Aggregate Surface:
 - 1. Excavate minimum of 6 inches.
 - 2. Place geotextile fabric full width and length, with minimum 12 inch overlap at joints.
 - 3. Place and compact at least 6 inches of 1 1/2 to 3 1/2 inch diameter stone.
- C. Silt Fences:
 - 1. Store and handle fabric in accordance with ASTM D4873/D4873M.
 - 2. Where slope gradient is less than 3:1 or barriers will be in place less than 6 months, use nominal 16 inch high barriers with minimum 36 inch long posts spaced at 6 feet maximum, with fabric embedded at least 4 inches in ground.
 - 3. Where slope gradient is steeper than 3:1 or barriers will be in place over 6 months, use nominal 28 inch high barriers, minimum 48 inch long posts spaced at 6 feet maximum, with fabric embedded at least 6 inches in ground.
 - 4. Where slope gradient is steeper than 3:1 and vertical height of slope between barriers is more than 20 feet, use nominal 32 inch high barriers with woven wire reinforcement and steel posts spaced at 4 feet maximum, with fabric embedded at least 6 inches in ground.
 - 5. Install with top of fabric at nominal height and embedment as specified.
 - 6. Embed bottom of fabric in a trench on the upslope side of fence, with 2 inches of fabric laid flat on bottom of trench facing upslope; backfill trench and compact.
 - 7. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches, with extra post.
 - 8. Fasten fabric to wood posts using one of the following:
 - a. Four nails per post with 3/4 inch diameter flat or button head, 1 inch long, and 14 gauge, 0.083 inch shank diameter.
 - b. Five staples per post with at least 17 gauge, 0.0453 inch wire, 3/4 inch crown width and 1/2 inch long legs.
 - 9. Fasten fabric to steel posts using wire, nylon cord, or integral pockets.
 - 10. Wherever runoff will flow around end of barrier or over the top, provide temporary splash pad or other outlet protection; at such outlets in the run of the barrier, make barrier not more than 12 inches high with post spacing not more than 4 feet.
- D. Mulching Over Large Areas:

1. Dry Straw and Hay: Apply 2-1/2 tons per acre; anchor using dull disc harrow or emulsified asphalt applied using same spraying machine at 100 gallons of water per ton of mulch.
 2. Wood Waste: Apply 6 to 9 tons per acre.
 3. Erosion Control Matting: Comply with manufacturer's instructions.
- E. Mulching Over Small and Medium Areas:
1. Dry Straw and Hay: Apply 4 to 6 inches depth.
 2. Wood Waste: Apply 2 to 3 inches depth.
 3. Erosion Control Matting: Comply with manufacturer's instructions.
- F. Temporary Seeding:
1. When hydraulic seeder is used, seedbed preparation is not required.
 2. When surface soil has been sealed by rainfall or consists of smooth undisturbed cut slopes, and conventional or manual seeding is to be used, prepare seedbed by scarifying sufficiently to allow seed to lodge and germinate.
 3. If temporary mulching was used on planting area but not removed, apply nitrogen fertilizer at 1 pound per 1000 sq ft.
 4. On soils of very low fertility, apply 10-10-10 fertilizer at rate of 12 to 16 pounds per 1000 sq ft.
 5. Incorporate fertilizer into soil before seeding.
 6. Apply seed uniformly; if using drill or cultipacker seeders place seed 1/2 to 1 inch deep.
 7. Irrigate as required to thoroughly wet soil to depth that will ensure germination, without causing runoff or erosion.
 8. Repeat irrigation as required until grass is established.

3.05 MAINTENANCE

- A. Comply with the project permit conditions.
- B. Maintain erosion control measures until disturbed earth has been restored with pavement or vegetation.
- C. Erosion Control Inspection: Per 210.1(a)
- D. Repair deficiencies immediately.
- E. Silt Fences:
1. Promptly replace fabric that deteriorates unless need for fence has passed.
 2. Remove silt deposits that exceed one-third of the height of the fence.
 3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
- F. Clean out temporary sediment control structures weekly and relocate soil on site.
- G. Place sediment in appropriate locations on site; do not remove from site.
- H. Where vegetative cover has been placed, inspect until vegetative cover is established and functioning as intended.

3.06 CLEAN UP

- A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architect.
- B. Clean out temporary sediment control structures that are to remain as permanent measures.
- C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION

SECTION 01 58 13
TEMPORARY PROJECT SIGNAGE

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Project identification sign.
- B. Flexible Facility Program (FFP) sign.

1.02 QUALITY ASSURANCE

- A. Design sign and structure to withstand 50 miles (80.47 kilometers)/hr wind velocity.
- B. Sign Painter: Experienced as a professional sign painter for minimum three years.
- C. Finishes, Painting: Adequate to withstand weathering, fading, and chipping for duration of construction.

1.03 SUBMITTALS

- A. See Section 01 30 00 – Administrative Requirements for submittal procedures.
- B. Shop Drawing: Show content, layout, lettering, color, structure, sizes.

PART 2 - PRODUCTS

2.01 SIGN MATERIALS

- A. Structure and Framing: New, wood, structurally adequate.
- B. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum ¾" thick, standard large sizes to minimize joints.
- C. Rough Hardware: Galvanized
- D. Must be erected outdoors and weatherproofed for outdoor posting

2.02 PROJECT IDENTIFICATION SIGN

- A. One (1) painted sign, 32 sq ft area, bottom 6 feet (182.88 cm) above ground.
- B. Content:
 - 1. Project title, City of Madison, Library and Parks logos and name of Owner as indicated on Contract Documents.
 - 2. Names and title of Architect.
 - 3. Name of Prime Contractor.
 - 4. Full color project rendering from high resolution image as furnished by Architect.

2.03 FLEXIBLE FACILITY PROGRAM (FFP) SIGN

- A. One (1) painted sign, 32 sq ft area, on a single 4' x 8' sheet. Bottom 6 feet (182.88 cm) above ground.
- B. Requirements:
 - 1. Must be on plywood panel APA Rated A-B Grade-Exterior (any alternative material must be pre-approved by DEHCR)
 - 2. The smallest print must be readable from 50 feet (1524 cm) away
 - 3. See Template Example Below for Content Requirements
 - 4. Background must be WHITE.
 - 5. See Template Example Below for Font color requirements (BLACK and RED)

C. Template Example:

City of Madison
Imagination Center at Reindahl Park Construction & Digital Connectivity Improvements Project:
A COMMUNITY FACILITIES PARTNERSHIP FINANCED IN PART BY THE CAPITAL PROJECTS FUND AND FLEXIBLE FACILITIES PROGRAM GRANT FUNDS FROM THE WISCONSIN DEPARTMENT OF ADMINISTRATION AND THE U.S. DEPARTMENT OF TREASURY
Tony Evers, Governor Kathy Blumenfeld, Secretary
Satya Rhodes-Conway, Mayor
State and Federal Equal Opportunity laws apply in the construction and use of this project.

PART 3 - EXECUTION**3.01 INSTALLATION**

- A. Install project identification sign within 30 days after date fixed by Notice to Proceed.
- B. Erect at exterior designated location.
- C. Install sign surface plumb and level, with butt joints. Anchor securely.

3.02 REMOVAL

- A. Remove sign, framing supports, and foundations at completion of Project and restore the area.

END OF SECTION

SECTION 01 60 00 PRODUCT REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

- A. The purpose of this specification is to provide general guidelines and responsibilities related to the receiving, handling, and storage of all materials and products from arrival on the job site through installation.
 - 1. Immediate inspection of delivered goods means a timely replacement if damaged.
 - 2. Proper storage helps prevent damage and loss by weather, vandalism, theft, and job site accidents.
 - 3. Proper storage helps with job site performance and safety.
 - 4. Proper handling helps prevent damage and job site accidents.
- B. Each Contractor shall be directly responsible for the receiving, handling, and storage of all materials and products associated with the Work of their Division or Trade.
- C. Each Contractor responsible for Work associated with Owner provided materials or products shall be responsible for the receiving, handling and storage of the material/product as outlined in Section 3.08 below..

1.02 RELATED SPECIFICATIONS

- A. Parts of this specification will reference articles within “The City of Madison FACILITIES MANAGEMENT SPECIFICATIONS for Public Works Construction”.
 - 1. Use the following link to access the FACILITIES MANAGEMENT SPECIFICATIONS web page:
<http://www.cityofmadison.com/business/pw/specs.cfm>
 - a. Click on the “Part” chapter identified in the specification text. For example if the specification says “Refer to City of Madison FACILITIES MANAGEMENT SPECIFICATION 210.2” click the link for Part II, the Part II PDF will open.
 - b. Scroll through the index of Part II for specification 210.2 and click the text link which will take you to the referenced text.
 - c. City Standard Detail Drawings (SDD) may be located from the index in Part VIII.
- B. Section 01 57 21 - Indoor Air Quality.
- C. Section 01 74 13 - Progress Cleaning.
- D. Section 01 76 00 - Protecting Installed Construction.
- E. Other Divisions and Specifications that may address more specifically the requirements for the storage and handling of materials and products associated Work of other Divisions or Trades.

1.03 QUALITY ASSURANCE

- A. The GC shall be responsible for ensuring that these minimum storage and handling requirements are met by all contractors on the project site including but not limited to the following:
 - 1. Receiving deliveries of materials, products, and equipment.
 - a. Inspect all deliveries upon arrival for damage, completeness, and compliance with the construction documents.
 - 1) Deliveries shall remain in original packaging or crates, shipping manifest shall be kept with the delivery and the packaging shall have visible identification of the items within the packaging.
 - b. Immediately report any damaged products or equipment to the GC, begin arrangements for immediate replacement.
 - c. Materials or equipment that have been damaged, are incomplete, or do not comply with the construction documents shall not be permitted to be installed.

2. All materials and products shall be stored within the designated limits of the project site. Only store the amount of material necessary for upcoming operations so as not to interfere with other construction activities and access to Work by the Owner and Architect. Any offsite storage shall be at the expense of the contractor storing the material or product. All offsite storage requirements shall comply with this specification. All offsite storage of materials is subject to Owner Representative Quality Management review at any time.
 3. Large storage containers may be used but shall be weather tight, securable, placed on concrete blocks, timbers, or jack stands and shall be level.
 4. When lifting equipment is required the equipment rating shall be greater than the loading requirements of the item being lifted. In addition all of the following shall apply as necessary:
 - a. Only designated and/or designed lift points shall be used.
 - b. Large items shall have tag lines and handlers at all times during lifting operations.
 - c. Lift at multiple points as needed to prevent bending.
 5. Materials and products stored inside of the structure shall comply with all of the following:
 - a. Storage shall not be allowed to impede the flow of work in progress.
 - b. Storage shall not be allowed to hide completed work from review and inspections.
 - c. Storage shall not exceed the design loads of the structural components it is being stored upon.
 6. All materials and products shall be stored according the manufacturers minimum recommended requirements. All of the following shall be considered before storing any product or material:
 - a. Dust and dirt
 - b. Moisture and humidity, including rain and snow
 - c. Excessive temperatures, direct sun, etc
 - d. Product or material weight and size
 - e. Potential for breakage
 - f. Product incompatibility with other products such as corrosiveness, chemical reactions, flammability, etc.
 - g. Product or material value and replacement cost
 7. The Contractor shall be responsible for providing fully functional tarps or plastic wrap, to protect materials and products from the weather. All coverings shall be free of large holes and tears, and shall be tied, strapped, or weighted down to resist blowing.
 8. The Contractor shall be responsible for any temporary heating, cooling, or other utility requirement that may be associated with the storage of a material or product.
 9. The Contractor shall be responsible for securing materials and products of value such as copper, A/V equipment, etc. Such items shall be stored in securable shipping containers, job trailers or other such storage devices. Container shall be kept secured when not in use.
- B. The GC shall inspect the job site daily to ensure that all products and materials stay weather tight and are secured against vandalism or theft as required by this specification.
- C. The Owners Representative may at any time request improvements regarding storage of any material or product being provided under these construction documents.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.01 GENERAL CONTRACTOR REQUIREMENTS

- A. Designate material storage and handling areas as needed including all of the following:
1. Designate specific areas of the site for delivery and storage of materials to be used during the execution of the Work.
 2. Designated areas shall not be located so as to interfere with the installation of any Work including Work by others such as the installation of utilities or the maintenance of existing utilities. This shall include not storing items in active utility easements as designated by the site plan.

- B. Arrange for openings in the building as needed to allow delivery and installation of large items. Openings shall be appropriately sized to include the use of booms, slings, and other such lifting devices that may be larger than the item being installed.
 - 1. When openings are required in completed Work (new or existing) the GC shall be responsible for providing an appropriate opening and for restoring the opening to the original or better condition upon completion. Restoration shall be weather tight and complete.
- C. Repeated moving and handling of items being stored shall not be allowed. The GC shall be responsible for any damage and replacement because of mishandling or excessive handling.

3.02 BULK MATERIAL

- A. Bulk material such as sand, gravel, top soil and other types of fill shall be stored away from the construction area and shall be stock piled as follows:
 - 1. All bulk material shall be piled safely and efficiently in as small an area as practical. Only store the amount of material necessary for upcoming operations so as not to interfere with other construction activities and access to Work by the Owner and Architect.
 - 2. All stock piles shall have silt fence/sock properly installed around the perimeter to prevent erosion and loss of material. Refer to City of Madison FACILITIES MANAGEMENT SPECIFICATION Section 210.1(f) and other related specification or details.
 - 3. Fine grained material shall be protected with tarps to prevent blowing. Tarps shall be weighted or staked to stay in place.
- B. Bulk material such as brick, concrete block, stone, and other palletized materials shall be stored on original shipping pallets until ready for use.

3.03 DRY PACKAGED MATERIAL

- A. Dry packaged material such as cement, mortar, etc shall be stored on pallets, on slightly elevated ground or clear stone pad to keep water away from the base of the material being stored. Protect from moisture.

3.04 STRUCTURAL AND FRAMING MATERIAL

- A. All structural and framing material shall be stored in an organized manner arranged by type, size and dimension. Materials shall be stored on pallets or timbers as necessary and shall not be allowed to lie directly on the ground.
- B. Long and heavy items shall be supported at several points to prevent bending and warping.

3.05 EQUIPMENT

- A. Equipment delivered to the site shall be stored away from all construction activities until the item can either be moved inside or properly installed.
- B. Equipment shall be stored on slightly elevated ground or clear stone pad to keep water away from the base of the equipment.

3.06 FINISH PRODUCTS

- A. Finish products such as flooring, tile, counters, lockers, toilets, partitions, lighting, and other similar items should not be delivered and stored until the structure has been enclosed, is weather tight, temperature controlled and the contractor is ready for such items to be installed.
 - 1. Storage of finished products outside for any length of time shall not be allowed.
- B. Products that cannot be stored inside the structure shall be stored in secured containers or job trailers until such time as they are ready to be installed.
- C. Products with a high potential for breakage such as glass, mirrors, tiles, toilet fixtures, etc. shall be stored with additional protection as necessary such as but not limited to the following:
 - 1. Store in original shipping containers until ready for installation.
 - 2. Do not store in high traffic areas.
 - 3. Shield with other materials such as cardboard, plywood, or similar products.

3.07 DUCTWORK, PIPING, AND CONDUIT

- A. All piping and conduit shall be stored horizontally unless otherwise specified by the manufacturer or Division and Trade Specifications.
 - 1. Do not store directly on grade.
 - 2. Cover metal pipes and tubes to prevent rust and corrosion, allow ventilation to prevent condensation.
 - 3. Whenever possible use pipe stands for storing pipe and conduit to prevent tripping and rolling hazards.
- B. All ductwork shall be stored horizontally or vertically as necessary unless otherwise specified by the manufacturer or Division and Trade Specifications.
 - 1. During storage, both ends of each duct shall be protected with plastic sheathing to prevent dust and dirt from getting inside the duct. Sheathing shall be sufficiently taped to the duct.
 - 2. After installation, free/open ends shall remain protected with taped plastic sheathing and or temporary filters as specified by division or Trade specifications.

3.08 OWNER PROVIDED, CONTRACTOR INSTALLED EQUIPMENT

- A. Section 3.08.A. shall apply to all equipment being provided to any contractor directly from the Owner for installation under the contract.
 - 1. The Owner or Owners Representative shall do the following:
 - a. Inspect all deliveries upon receipt and notify manufacturer of any issues directly.
 - b. Review the received shipment with the contractor.
 - 1) Only provide products or materials to the contractor that were not damaged through shipping or handling.
 - 2) Confirm missing products or materials and anticipated delivery schedule if known.
 - 2. The Contractor responsible for the installation of Work associated with Owner provided materials or products shall "take ownership" and provide safe and secure storage and handling as previously described within this specification.
 - a. The Contractor shall be liable for the repair or replacement of any material or product damaged after taking ownership of the product from receipt through final acceptance.
- B. Section 3.08.B. shall apply to all equipment being provided by the Owner but shipped directly to any sub-contractor or the project site for installation under the contract.
 - 1. The GC and/or Contractor responsible for the Work associated with the Owner provided materials or products shall do the following:
 - a. Inspect all deliveries upon receipt and notify the Owner or Owners Representative of any issues directly.
 - 1) Owner or Owners Representative shall notify manufacturer of any issues directly.
 - b. Review the received shipment with the Owner or Owners Representative
 - 1) Confirm missing products or materials and anticipated delivery schedule if known.
 - 2. The Contractor shall "take ownership" and provide safe and secure storage and handling as previously described within this specification.
 - a. The Contractor shall be liable for the repair or replacement of any material or product damaged after taking ownership of the product from receipt through final acceptance.

END OF SECTION

SECTION 01 61 16
VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for Indoor-Emissions-Restricted products.
- B. Requirements for VOC-Content-Restricted products.

1.02 RELATED REQUIREMENTS

- A. Section 01 40 00 - Quality Requirements: Procedures for testing and certifications.
- B. Section 01 60 00 - Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.
- C. Section 01 81 13 - Sustainable...: For VOC levels required for LEED.
- D. Section 07 92 00 - Joint Sealants: Emissions-compliant sealants.

1.03 DEFINITIONS

- A. Indoor-Emissions-Restricted Products: All products in the following product categories, whether specified or not:
 - 1. Interior paints and coatings applied on site.
 - 2. Interior adhesives and sealants applied on site, including flooring adhesives.
 - 3. Flooring.
 - 4. Composite wood.
 - 5. Products making up wall and ceiling assemblies.
 - 6. Thermal and acoustical insulation.
 - 7. Other products when specifically stated in the specifications.
- B. VOC-Content-Restricted Products: All products in the following product categories, whether specified or not:
 - 1. Interior paints and coatings applied on site.
 - 2. Interior adhesives and sealants applied on site, including flooring adhesives.
- C. Interior of Building: Anywhere inside the exterior weather barrier.
- D. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
- E. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.
- F. Inherently Non-Emitting Materials: Products composed wholly of minerals or metals, unless they include organic-based surface coatings, binders, or sealants; and specifically the following:
 - 1. Concrete.
 - 2. Clay brick.
 - 3. Metals that are plated, anodized, or powder-coated.
 - 4. Glass.
 - 5. Ceramics.
 - 6. Solid wood flooring that is unfinished and untreated.

1.04 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings; 2005 (Reapproved 2018).

- C. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2020.
- D. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).
- E. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).

1.05 SUBMITTALS

- A. See 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.
- C. Sustainable Design Reporting: Submit evidence of compliance.

1.06 QUALITY ASSURANCE

- A. VOC Content Test Method: 40 CFR 59, Subpart D (EPA Method 24), or ASTM D3960, unless otherwise indicated.
 - 1. Evidence of Compliance: Acceptable types of evidence are:
 - a. Report of laboratory testing performed in accordance with requirements.
- B. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

PART 2 PRODUCTS

2.01 MATERIALS

- A. VOC-Content-Restricted Products: VOC content not greater than required by the following:
 - 1. Adhesives, Including Flooring Adhesives: SCAQMD 1168 Rule.
 - 2. Joint Sealants: SCAQMD 1168 Rule.
 - 3. Paints and Coatings: Each color; most stringent of the following:
 - a. 40 CFR 59, Subpart D.
 - b. SCAQMD 1113 Rule.
 - c. CARB (SCM).
 - 4. Wet-Applied Roofing and Waterproofing: Comply with requirements for paints and coatings.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.
- B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

END OF SECTION

**SECTION 01 71 23
FIELD ENGINEERING****PART 1 – GENERAL****1.01 REQUIREMENTS INCLUDED**

- A. The Contractor shall provide and pay for field engineering services required for the Project:
 - 1. Land surveying services required to execute the Work, to include building addition location and layout, and location and layout of pavements and all proposed site improvements.
 - 2. Verification of existing building dimensions, elevations, and relationship to proposed additions.
 - 3. Professional Engineering services to execute Contractor's construction methods.
 - 4. Registered Professional Engineer in the State of Wisconsin to determine the load capacity of the existing structure for use of Contractors temporary facilities, equipment, lifts, machinery, material storage, etc.

1.02 RELATED REQUIREMENTS

- A. Conditions of the Contract.

1.03 PROCEDURES

- A. A property survey has been prepared for the Owner and has been bound with Contract Drawings. Surveys shall describe physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. If information is incomplete, notify Owner to furnish additional information. Verify easement locations, front, side, and rear yard restrictions, if any; and property line locations. Verify control points, and establish bench marks. Locate and layout roads, walks, parking areas and all civil structures and all proposed site improvements.
- B. Verify locations of underground services, utilities, structures, etc. which may be encountered or affected by the Work.

1.04 PROJECT SURVEY REQUIREMENTS

- A. Using datum, the lot lines and present levels have been established as indicated on the Drawings. Other grades, lines, levels and benchmarks, shall be established and maintained by the Contractor, who shall be responsible for them. As work progresses, the Contractor shall layout on forms and floor, the locations of all partitions, walls and fix column centerlines as a guide to all trades. The Contractor shall make provision to preserve property line stakes, benchmarks, or datum point. If any are lost, displaced or disturbed through neglect of any Contractor, Contractor's agents or employee, the Contractor responsible shall pay the cost of restoration.
- B. Establish lines and levels, locate and layout, by instrumentation and similar appropriate means, additions, column locations, floor levels, stakes for walks, etc.
- C. Provide data to all Subcontractors for their use as applicable.
- D. From time to time, verify layouts by same methods.

1.05 RECORDS

- A. Maintain a complete, accurate log of all control and survey work as it progresses.

PART 2 – PRODUCTS – THIS SECTION NOT USED**PART 3 – EXECUTION – THIS SECTION NOT USED****END OF SECTION**

SECTION 01 73 29 CUTTING AND PATCHING

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes general procedural requirements for cutting and patching including, but not limited to the following:
 - 1. Examination.
 - 2. Preparation.
 - 3. Performance.
 - 4. Cleanup and Restoration.

1.02 RELATED SPECIFICATION SECTIONS

- A. Divisions 02 through 32 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
- B. Division 07 Section "Penetration Fire Stopping" for patching fire-rated construction.

1.03 DEFINITIONS

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

1.04 QUALITY ASSURANCE

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

1.05 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.
- B. All cutting and patching work performed under this contract shall be warranted like new work as defined by the Specification governing the work.

PART 2 - MATERIALS**2.01 GENERAL**

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

PART 3 - EXECUTION**3.01 EXAMINATION**

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

3.02 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect in-place construction and existing conditions during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations. If the failure to protect, or the lack of protection, of in-place construction and/or existing conditions results in damage, the contractor shall be responsible for repair to previous condition.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to eliminate interruption to occupied areas.

3.03 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut 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. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots 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. Concrete or Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
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- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
- D. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

3.04 CLEANUP AND RESTORATION

- A. 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.
 - 1. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - 2. Restore damaged pipe covering to its original condition.
 - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - 4. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 - 5. Ceilings: Patch, repair, or re-hang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 - 6. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weather tight condition.
 - 7. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.
 - 8. Any smoke and fire caulking that has been disturbed must be replaced by the Contractor as required by

END OF SECTION

**SECTION 01 74 13
PROGRESS CLEANING****PART 1 – GENERAL****1.01 SUMMARY**

- A. Throughout the execution of this contract all contractors shall be responsible for maintaining the project site in a standard of cleanliness as described in this specification.
- B. All contractors shall also comply with the requirements for cleaning as described in other specifications.
- C. Work included in this specification shall include but not be limited to:
 - 1. Safety Cleaning.
 - 2. Project Site Cleaning.
 - 3. Progress Cleaning.
 - 4. Final Cleaning.

1.02 RELATED SPECIFICATIONS

- A. Section 01 35 00 - Special Procedures.
- B. Section 01 60 00 - Product Requirements.
- C. Section 01 74 19 - Construction Waste Management and Disposal.
- D. Section 01 76 00 - Protecting Installed Construction.

1.03 QUALITY ASSURANCE

- A. The General Contractor (GC) shall conduct daily inspections, more often if necessary, of the entire project site to ensure the requirements of cleanliness are being met as described within these specifications.
- B. All contractors shall comply with other regulatory requirements as they apply to waste recycling, reuse, hauling, and disposal requirements of any governmental authority having jurisdiction.
- C. The Owner reserves the right to have work done by others in the event any contractor fails to perform cleaning as described within these specifications. The cost of any Owner provided cleaning shall be charged to the contractor through a deduct change order.

PART 2 - PRODUCTS**2.01 CLEANING MATERIALS AND EQUIPMENT**

- A. The Contractor shall provide all required personnel, equipment, and materials necessary to maintain the required level of cleanliness as described in this specification.
- B. Use only cleaning materials and equipment that are compatible with the surface being cleaned, as recommended by the manufacturer, or as approved by the A/E.
- C. Use only cleaning materials, equipment, and methods as recommended in the manufacturers care and use guide of the material, finish or equipment being cleaned.

PART 3 - EXECUTION**3.01 SAFETY CLEANING**

- A. All Contractors shall be responsible for safety cleaning as required by OSHA and other regulatory requirements as applicable.
 - B. Safety Cleaning shall include but not be limited to the following:
 - 1. All work areas, passageways, ramps, and stairs shall be kept free of debris, scrap materials, pallets, and other large items that would obstruct exiting routes. Small items such as tools, electrical cords, etc are picked up when not in use.
 - 2. Form and scrap lumber shall have nails/screws removed or bent over. Lumber shall be neatly stacked in an area designated by the GC.
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3. Spills of oil, grease, and other such liquids shall be cleaned immediately or sprinkled with sand/oil-dry first, then cleaned.
4. Oily, flammable, or hazardous items shall be stored in appropriate covered containers and storage devices unless actively being used.
5. Oily, or flammable rags, and other such waste shall only be disposed of in authorized covered containers.
6. Disposal by burning shall not be allowed at any time.

3.02 PROJECT SITE CLEANING

- A. This section applies to the general cleanliness of the project site as a whole for the duration of the execution of this contract.
- B. Exterior Project Site Areas
 1. The GC and other Contractors as appropriate shall ensure the following levels of cleanliness are applied to the exterior project site areas.
 - a. The overall appearance of the project site is neat and orderly. Defined areas for material storage, material waste, job trailers, and the project area are clean and well maintained.
 - b. The construction fence is maintained, erect with no gaps, and properly posted per all regulatory requirements.
 - c. All erosion control measures are properly maintained, cleaned, and repaired as necessary.
 - d. All loose materials (construction or waste) are properly tied or weighted down to resist blowing.
 - e. All construction materials are properly covered with fully functional tarps or plastic wrap, protected from the weather, coverings are tied, strapped, or weighted down to resist blowing.
 - f. Dust control is applied as necessary or as required by any regulatory requirement.
- C. Interior Project Site Areas
 1. All Contractors shall ensure the following levels of cleanliness are applied to the interior project site areas.
 - a. The overall appearance of the project site is neat and orderly. Defined areas for material storage, material waste, and project area are clean and well maintained.
 - b. Stored materials are kept in original shipping containers whenever possible. Stored materials not in shipping containers are properly stored and protected according to other applicable specifications.
 - c. All scraps and debris shall be properly disposed of as often as necessary to keep work areas, passageways, stairs, and ramps free of debris and clear for emergency exiting.
 - d. Boxes, pallets, and other such shipping containers, are broken down, stored in a consolidated area or, disposed of as often as is necessary.
 - e. Hand tools, supplies, materials, electrical cords not being used are picked up and stored in gang boxes, not left as walking hazards in work areas, passageways, etc.
- D. Job Trailer
 1. The interior of the job trailer shall be kept clean and available as a work space at all times. The GC shall ensure that the following is provided for within the job trailer:
 - a. Meeting space including tables and chairs.
 - b. Sufficient space for all contractors to access the official construction documents, provide updates, etc.

3.03 PROGRESS CLEANING

- A. This sub-section shall apply to all Progress Cleaning prior to the installation of finishes, fixtures, and trim (i.e. rough-in).
 1. For the purposes of this section "clean" shall be defined as a level of cleanliness free of dust and other material capable of being removed by use of reasonable effort using a good quality janitor broom and shop-vac.

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2. Daily cleanings shall be conducted by all contractors at the end of the work day as follows:
 - a. Debris in excavated areas shall be removed prior to backfill and compaction.
 - b. Debris in wall cavities, chase spaces, etc shall be removed prior to enclosing the spaces.
 - c. Large items shall be properly stored, returned to designated areas, or disposed of as necessary.
 - d. Loose materials shall be properly secured.
 - e. Flammable or hazardous materials are properly stored or disposed of.
 3. Weekly cleaning shall be conducted by all contractors as designated by the GC. Weekly cleanings shall include all the above for a daily cleaning and other necessary cleaning as designated by the GC.
- B. This sub-section shall apply to Progress Cleaning in preparation for the installation of finishes, fixtures, and trim.
- a. Surfaces receiving finishes shall be thoroughly cleaned prior to contractors applying finish materials. The GC shall be responsible for inspecting the area and surfaces being cleaned for finish prior to the sub-contractor applying the finish. This shall include but not be limited to the following:
 - 1) Wall surfaces shall be wiped clean of dirt and oily residues, vacuumed free of dust, and shall be free of surface imperfections prior to painting or installing wall coverings.
 - 2) Metal surfaces shall be wiped clean of dirt and oily residues, and be free of surface imperfections prior to painting.
 - 3) Flooring shall be broom swept of large and loose items then vacuumed clean of dust and small particles, and damp mopped clean and dried prior to installing any flooring finish. Additional cleaning may be required depending on the preparation requirements recommended by the flooring material manufacturer.
- C. This sub-section shall apply to Progress Cleaning after the installation of finishes, fixtures, and trim.
1. For the purposes of this section "clean" shall be defined as a level of cleanliness free of dust and other material capable of damaging or visually disfiguring finished work, finishes, fixtures, and trim.
 2. Progress Cleaning at this point in the contract shall be conducted immediately as follows:
 - a. Dust, dirt, etc shall be swept and vacuumed off of finish flooring and trim.
 - b. Liquid spills shall be cleaned up according to the spill type. This shall include drips and spills caused by paint, stain, sealants, and other such items.
 3. The Contractor(s) at no additional cost to the Owner shall be responsible for replacing any finished work, finishes, fixtures, and trim damaged or disfigured because of inadequate or improper cleaning.

3.04 FINAL CLEANING

- A. As noted in Specification 01 29 76 - Progress Payment Procedures, Progress Payment Milestone Schedule, Final Cleaning shall not be conducted prior to requesting the 90% contract total progress payment and all of the following shall be complete:
1. All final regulatory inspections including but not limited to Building Inspection Department and Madison Fire Department inspections have been successfully completed.
 2. All Quality Management Observation (QMO) reports have been closed out.
 3. All Demonstration and Training has been completed.
 4. All Attic Stock has been consolidated and located to its designated area
 5. All protection for installed construction shall be removed prior to final cleaning by the contractor responsible for providing the protections. This shall include the removal of any adhesive residues left behind from tapes. Contractors shall only use manufacturer authorized cleaning materials for removing adhesives, etc.
- B. For the purposes of this section "clean" shall be defined as a level of cleanliness generally provided by skilled cleaners using commercial quality building maintenance equipment and materials.
- C. The GC shall be responsible for ensuring that all requirements under this section are being met.
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D. General Requirements

1. Employ experienced personnel or professional cleaners for final cleaning as necessary for the areas or equipment being cleaned.
2. Cleaning equipment used shall be commercial grade equipment commonly used by professional cleaners.
3. Cleaning equipment and materials shall be cleaned, rinsed, or replaced to ensure a uniform level of cleanliness is being maintained during the final cleaning. This shall include but not be limited to the following:
 - a. Vacuum cleaner bags and/or filters are changed and/or cleaned as often as necessary.
 - b. Dust & wipe down rags are washed, rinsed, or replaced before starting each room.
 - c. Mopping equipment
 - 1) Mop water for washing shall have cleaning solution added to the amount and temperature per manufacturer's recommendations. Mop washing water shall be replaced often to maintain the levels of the cleaning solution and temperature required.
 - 2) Mop water for rinsing shall remain clean, clear, and be replaced as often as necessary.
 - 3) Mop heads shall be rinsed often and replaced as necessary.
 - 4) Mop heads and buckets shall be thoroughly rinsed with each change of water.
 - 5) Only new mop heads shall be used for rinsing.

E. Refer to all other specifications in this contract for specific requirements regarding final cleaning of finishes, fixtures, equipment, etc.**F. Exterior Cleaning shall include but not be limited to the following:**

1. All exterior glazing surfaces have been professionally cleaned and are free of dust and streaking.
2. Metal roofs, siding, and other surfaces shall be clean of dirt and free of splashed or excess materials such as sealants, mortar, paint, etc.
3. All exterior furnishings shall be clean, waste receptacles shall be empty.
4. Paved areas shall be clean, free of dirt, oily stains and other such blemishes
5. Exterior lights and diffusers are clean and free of dust.

G. Interior Cleaning shall include but not be limited to the following:

1. Remove all labels, stickers, tags, and other such items which are not required by code as permanent labels.
2. All interior glazing surfaces, including mirrors, have been professionally cleaned and are free of dust and streaking.
3. All interior surfaces have been cleaned of excess materials such as paint, sealants, etc and have been wiped free of dust.
4. Interior metals, fixtures, and trim have been cleaned free of dust and oily residues
5. Carpet flooring has been thoroughly cleaned; vacuumed free of dust, excess glues and other stains removed per manufacturers use and care instructions.
6. Resilient flooring has been thoroughly cleaned; vacuumed free of dust, excess glues and other stains removed, mopped and buffed per manufacturers use and care instructions.
7. Interior non-occupied concrete floors shall be broom cleaned, vacuumed free of dust, excess glues and other stains removed per manufacturers use and care instructions.
8. Light fixtures, lamps, diffusers and other such items have been dusted and cleaned as necessary.

3.05 CALL BACK WORK

- A. The GC shall be responsible for ensuring that any contractor returning to the project site for completion or correction work has re-cleaned and restored the area to the levels described in section 3.04 above upon completion of the work. This shall include but not be limited to the following:
1. The immediate area(s) where work was completed.
 2. Adjacent areas where dust or debris may have traveled.
 3. Other areas occupied during the completion of the call back work.
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4. Path of entrance/exit, to/from the area(s) of work.

END OF SECTION

SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 – GENERAL

1.01 SUMMARY

- A. This specification includes administrative and procedural requirements for the recycling, re-use, salvaging, and disposal of non-hazardous construction and demolition waste.
- B. The General Contractor (GC) shall be fully responsible for complying with all applicable ordinances and other such regulatory requirements during the execution of this contract.

1.02 RELATED SPECIFICATIONS

- A. 01 29 76 - Progress Payment Procedures.
- B. 01 31 23 - Project Management Web site.
- C. 01 32 19 - Submittals Schedule.
- D. 01 33 23 - Submittals.
- E. 01 77 00 - Closeout Procedures.
- F. Other Divisions and Specifications that may address the proper disposal of construction or demolition waste as it pertains to work being conducted under that particular specification.

1.03 CITY ORDINANCES

- A. There are two (2) Madison General Ordinances (MGO) that the City of Madison has regarding construction and demolition waste.
 - 1. MGO 10.185, Recycling and Reuse of Construction and Demolition Debris, describes the requirements associated with this ordinance including definitions, documentation requirements, and penalties.
 - 2. MGO 28.185, Approval of Demolition (Razing, Wrecking) and Removal, describes the requirements associated with applying for and receiving a demolition permit.
- B. All City of Madison, Board of Public Works, contracts being conducted by City Engineering, Facility Management, for construction, remodeling, or demolition shall comply with the above ordinances regardless of project type or size.

1.04 DEFINITIONS

- A. Clean: Untreated and unpainted material, free of contamination caused by oils, solvents, caulks, and other chemicals.
- B. Construction and Demolition Debris: Materials resulting from the construction, remodeling, repair, and demolition of utilities, structures, buildings, and roads.
- C. Disposal: Off-site removal of construction and demolition debris and the subsequent sale, recycling, reuse, or deposit in authorized landfill or incinerator.
- D. Hazardous: Exhibiting the characteristics of hazardous substance, i.e. ignitability, corrosiveness, toxicity, or reactivity and including but not limited to asbestos containing materials, lead, mercury and PCBs.
- E. Non-hazardous: Exhibiting none of the characteristics of a hazardous substance.
- F. Nontoxic: Not immediately poisonous to humans or poisonous after a long period of exposure.
- G. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product.

- H. Recycle: Any process by which construction or demolition debris is diverted from final disposal as solid waste at a permitted landfill and instead is collected, separated, and/or processed into raw materials for new, reused, or reconstituted products; or for the recovery of materials for energy production processes.
- I. Recycler: Any recycling facility, transfer station, or other waste handling facility which accepts construction and demolition debris for recycling, or for other transferring to a recycling facility.
- J. Recycling: The process of sorting, cleaning, treating, or reconstituting solid waste and other discarded materials for the purpose of preparing the material to be recyclable. Recycling does not include burning, incinerating or thermally destroying waste.
- K. Return: To give back reusable items or unused products to vendors for credit.
- L. Reuse: Shall mean any of the following:
 - 1. The on-site use of reprocessed construction and demolitions debris.
 - 2. The off-site redistribution of a material, for use in the same manner or similar manner at another location.
 - 3. The use of non-toxic, clean wood as an alternative fuel source.
- M. Salvage: To remove a waste material from the project site for resale or reuse by the Owner or others.
- N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- O. Trash: Any product or material unable to be re-used, returned, recycled, or salvaged.
- P. Waste: Extra materials or products that have reached the end of its useful life or its intended use. Waste includes salvageable, returnable, recyclable and re-useable construction and demolition materials, and trash.

1.05 PERFORMANCE REQUIREMENTS

- A. The GC shall develop a Waste Management Plan that results in end-of-project rates for salvage/recycling/reuse of 95 percent (minimum) by weight of the total waste generated by the Work. Percentages may be adjusted on a project by project basis depending on selected LEED goals associated with the project.
- B. The GC shall salvage or recycle 100 percent of all uncontaminated packaging materials including but not limited to the following:
 - 1. Paper.
 - 2. Cardboard.
 - 3. Beverage containers.
 - 4. Boxes.
 - 5. Plastic Sheet and film.
 - 6. Polystyrene packaging.
 - 7. Wood crates and pallets.
 - 8. Plastic pails and buckets.
- C. Promote a resourceful use of supplies and materials through proper planning and handling. Generate the least amount of waste possible by minimizing errors, poor planning, breakage, mishandling, contamination or other similar factors.
- D. Use all reasonable means to divert construction waste from landfills and incinerators through recycling, reuse, or salvage as appropriate.

1.06 SUBMITTALS AND DELIVERABLES

- A. The GC shall provide their completed Waste Management Plan to the Project Management Web Site as a submittal for review by the Project Architect and City Project Manager.
 - 1. See item 1.8 below for Waste Management Plan submittal requirements.

2. The Waste Management Plan shall be completed, submitted, and approved as a pre-requisite for Progress Payment number 1.
 3. Copies of all documentation required by this specification shall be submitted to the appropriate Project Management Web Site Library. Documentation shall be reviewed by the City Project Manager during all Progress Payment reviews for compliance and accuracy.
- B. The Waste Management Coordinator shall provide copies of items 1 through 5 below to the appropriate Project Management Web Site Library and shall update the Waste Management Summary Log to reflect the records being submitted.
1. Records of Donations: Indicate receipt and acceptance of itemized salvageable waste donated to individuals or organizations. Indicate if the organization is tax exempt.
 2. Records of Sales: Indicate receipt and acceptance of itemized salvageable waste sold to individuals or organizations. Indicate if the organization is tax exempt.
 3. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts and invoices.
 4. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts and invoices.
 5. Statement of Refrigerant Recovery: The Refrigerant Recovery Technician responsible for recovering refrigerant shall provide the GC with a statement indicating all of the following:
 - a. All recovery was performed according to EPA Regulations.
 - b. All refrigerant present was recovered; indicate the total quantity recovered by unit.
 - c. Date of Recovery.
 - d. Name, address, company name, and phone number of technician performing the recovery.
 - e. Technician shall sign and date the statement.
- C. LEED Submittal: The GC shall provide the following information using the appropriate LEED letter template upon project completion: indicating that the requirements of the credit have been met.
- NOTE: This requirement shall only apply to projects having a LEED certification goal.
1. Total waste material generated.
 2. Total waste material diverted by diversion method; recycling, salvage, re-use, etc.
 3. Which waste streams have been diverted; minimum four different streams required to achieve LEED credit
 4. Statement that the credit requirements have been met.
 5. GC shall sign the letter.

1.07 QUALITY ASSURANCE

- A. Waste Management Coordinator: The GC shall be responsible for designating a Waste Management Coordinator. Coordinator may be the GC Supervisor, GC Project Manager or other member of the GC staff having knowledge of proper waste management procedures and all applicable regulations.
- B. Regulatory Requirements: comply with all hauling and disposal regulations of authorities having jurisdiction.
- C. The Waste Management Coordinator shall comply with Specification 01 31 19 - Project Meetings, Section 3.07.B.1 and conduct a Waste Management Conference at the job site. This conference shall be repeated as necessary as additional trades are added to the Work. The conference shall include but not be limited to the following:
1. Identify the Waste Management Coordinator; provide trade contractors with name, phone, and email information.
 2. Review and discuss the Waste Management Plan and the roles of the Coordinator.
 3. Review the requirements for documenting and reporting procedures of each type of waste and its disposition.

4. Review procedures for material separation; indicate availability and locations of containers and bins.
5. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
6. Review waste management procedures specific to each trade.

D. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

1.08 WASTE MANAGEMENT PLAN

- A. Develop a plan consisting of waste identification, a waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume. Use the same units of measure throughout the waste management plan.
 1. Waste Identification: Indicate anticipated types and quantities of site clearing, demolition waste, and construction waste that will be generated during the execution of this contract. Include assumptions for the estimates.
 2. Waste Reduction Work Plan: The work plan shall consist of but not be limited to all of the following:
 - a. Identify methods for reducing construction waste. Re-using, framing and forming materials, re-planning material cuts to minimize waste, etc.
 - b. Identify what types of materials will be recycled. Provide lists of local companies that receive and/or process the materials. Include names, addresses, and phone numbers.
 - c. Identify what types of materials will be disposed of and whether it will be disposed of in a landfill facility or by incineration facility. Provide lists of local companies that receive and/or process the materials. Include names, addresses, and phone numbers.
 - d. Identify methods to be used on site for separating waste including all of the following:
 - 1) Sizes of containers to be used.
 - 2) Labels to be used on the containers to identify the type of waste allowed in the container.
 - 3) Designated locations on the project site for waste material containers.
- B. If project requires demolition incorporate the ordinance required (MGO 28.185) Recycling and Reuse Plan into the Waste Management Plan.
- C. Provide all of the following for the Waste Management Coordinator:
 1. Name, employer, employer address, phone number, and email address of the designated coordinator.
 - a. The GC shall also provide this information with the required Project Directory Submittal at the beginning of the project.
- D. If at the option of the GC, they choose to contract with a Waste Management Disposal Company that allows comingled and unsorted waste materials, the GC shall include with their Waste Management Plan the following:
 1. Name, address, phone number, state permitting information, and other pertinent information about the disposal company.
 2. Documentation from the disposal company indicating company policies and procedures regarding comingled and unsorted waste materials to include:
 - a. GC responsibilities on the project site.
 - b. Disposal company procedures for receiving, sorting, recycling, and disposing of comingled and unsorted waste material.

PART 2 – PRODUCTS – THIS SECTION NOT USED**PART 3 - EXECUTION****3.01 PLAN IMPLEMENTATION**

- A. Implement the approved waste management plan. Provide adequate containers, storage space, signage, transportation and other items required to implement the plan during the execution of this contract.
- B. The GC and Waste Management Coordinator shall be responsible for monitoring and reporting the status of the Waste Management Plan and shall monitor the waste management practices on site as frequently as needed.
- C. Train all workers, sub-contractors, and suppliers on proper waste management procedures as appropriate for the work being conducted on the project site.
 - 1. Distribute the waste management plan to everyone concerned within seven (7) days of submittal approval.
 - 2. Distribute the waste management plan to new workers, sub-contractors, and suppliers when they first appear on the project site.
 - 3. Conduct additional training as needed during the execution of the contract to keep a positive focus on the waste management plan.
- D. Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent and used facilities.
 - 1. Designate and label specific areas on the project site necessary for separating materials to be salvaged, recycled, reused, donated, and sold.
 - 2. Comply with any specification or regulatory requirements pertaining to dust, dirt, environmental protection, and noise control.

3.02 HAZARDOUS AND TOXIC WASTE

- A. The Owner shall be responsible under separate contract for the removal of any asbestos related materials. All other materials shall be removed by the GC.
- B. All hazardous and toxic waste shall be separated, stored, and disposed of according to all applicable regulations.
- C. All hazardous and toxic materials on site shall have a Material Safety and Data Sheet (MSDS) available that indicates storage requirements, emergency information, and disposal requirements as necessary.

3.03 GENERAL GUIDELINES FOR ALL WASTES

- A. Recycle all paper and beverage containers used by workers, sub-contractors, suppliers and visitors to the project site.
- B. All revenues, savings, rebates, tax credits, and other such incentives received from recycling, reusing, or salvaging waste materials shall accrue to the GC unless specified otherwise in the contract documents.
- C. Separate recyclable, reusable, and salvageable waste from other waste materials, trash, and debris except where Waste Management Disposal Company allows comingled waste materials, see section 1.08.D above.
 - 1. Separate by type in appropriate containers or designated areas according to the approved waste management plan away from the construction area. Do not store within the drip lines of existing trees.
 - 2. Inspect containers and bins frequently for contamination and inappropriately sorted materials. Remove contaminated materials and resort as necessary.

3. Stockpile bulk materials such as sand, topsoil, stone, etc., on site away from the construction area and without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water, and cover to prevent windblown dust. Do not store within the drip lines of existing trees.
4. Whenever possible store items off the ground and/or protect them from the weather.

3.04 GUIDELINES FOR RECYCLABLE, RE-USABLE, AND SALVAGEABLE WASTE

- A. The following guidelines is not a complete or all inclusive list and shall be adjusted as needed by the methods and procedures identified in the Waste Management Plan.
- B. Asphalt Paving: Break-up into transportable pieces or grind, transport to an authorized recycling facility.
- C. Carpet and Pad: Separate carpet and pad scraps, containerize and transport to an authorized recycling facility.
- D. Ceiling System Components: Suspended ceiling system components shall be sorted by material type as follows:
 1. Broken, cut, or damaged tiles shall be containerized, transport to an authorized recycling facility.
 2. Damaged, or cut tracks, trim and other metal grid system components shall be sorted with other metals of similar types, palletize, transport to an authorized recycling facility.
- E. Clean Fill: When allowed by Division 31 Specifications; concrete, masonry, stone, asphalt pavement, sand and other such materials may be used as clean fill on this project site. The GC shall verify with the Project Architect, Structural Engineer, or Civil Engineer as necessary prior to using any materials as clean fill. Materials shall be processed, placed, and compacted as specified. If not being re-used on site, transport to an authorized recycling facility.
- F. Clean Wood Materials: Including but not limited framing cutoffs, wood sheathing or paneling materials, structural or engineered wood products, and pallets or crates. Clean Wood shall be free of paints, stains, oils, preservatives and other such contaminants.
 1. Useable pieces shall be sorted by type and dimension, bundled and transported off site by the GC or returned to the supplier.
 2. Non-useable pieces shall be palletized or containerized, transport to an authorized recycling facility.
 3. Clean, uncontaminated sawdust and wood shavings shall be bagged, transport to an authorized recycling facility.
- G. Concrete: Break-up into transportable pieces, remove all reinforcing and other metals, transport to an authorized recycling facility.
- H. Glass Products: Shall be sorted by types, do not include light fixture lamps and bulbs. Products broken in shipment shall be returned to the supplier. Broken or cracked items still in frames shall be taped to prevent further breakage and injury to workers. Transport to an authorized recycling facility.
- I. Gypsum Board: Stack large clean pieces on wooden pallets or container, store in a dry location, transport to an authorized recycling facility.
- J. Light Fixture Lamps and Bulbs: Fluorescent tubes shall be containerized, transport to an authorized recycling facility.
- K. Masonry and CMU: Remove all metal reinforcing, anchors, and ties, clean undamaged pieces and neatly stack on pallets, transport damaged pieces to an authorized recycling facility.
- L. Metals: Sort metals by type as follows, this does not include piping:
 1. Architectural metals including but not limited to siding, soffit, and roofing panels shall be sorted by material, palletize or bundle as needed and transport to an authorized recycling facility.
 2. Structural steel, sort by size and type; palletize and transport to an authorized recycling facility.

3. Miscellaneous metals such as aluminum, brass, bronze, etc shall be sorted by type, containerized or palletized as necessary, transport to an authorized recycling facility.
- M. Packaging and shipping materials
 1. Cardboard boxes and containers: Breakdown all cardboard boxes and containers into flat sheets. Bundle and store in a dry location until transported for recycling.
 2. Pallets:
 - a. Whenever possible require deliveries using pallets to remove them from the project site.
 - b. Neatly stack pallets in preparation for reusing them or providing them to other companies for salvage or re-use.
 - c. Break down pallets into component wood pieces that comply with the requirements for recycling clean wood materials. Neatly stack or palletize pieces in preparation for transportation.
 3. Crates: Break down crates into component wood pieces that comply with the requirements for recycling clean wood materials. Neatly stack or palletize pieces in preparation for transportation.
 4. Polystyrene Packaging: Separate and bag materials.
- N. Piping and conduit: Reduce all piping and conduit to straight lengths, sort and store by size, material and type. Remove supports, hangers, valves, boxes, sprinkler heads, and other such components, sort and store by size, material and type. Transport to authorized recycling facilities according to material types.
- O. Roofing: Roofing materials shall be sorted and containerized by type, transport to authorized recycling facilities according to material types.
- P. Site-Clearing Waste: Sort all site waste by type.
 1. Only stockpile soils types and quantities required for re-use on the project site. All remaining quantities shall be transported off site to an authorized facility that receives such materials.
 2. Brush, branches, and trees with no marketable re-use shall be transported to facilities for chipping into mulch.
 3. Trees with a marketable re-use shall be salvaged and transported to facilities that specialize in processing trees for future use as wood products.

3.05 GUIDELINES FOR DISPOSAL OF WASTES

- A. The following guidelines shall be adjusted as needed by the methods and procedures identified in the Waste Management Plan.
- B. Any waste that is contaminated, organic, or cannot be recycled, re-used, or salvaged shall be legally disposed of in an authorized landfill or incinerator. Disposal methods shall follow all applicable regulatory requirements.
- C. No waste material of any kind, except those types designated as clean fill in section 3.04 above, shall be allowed to be buried on the project site at any time.
- D. No burning of any kind of waste material shall be permitted on this project site at any time.
- E. Paint and Stain: Paints, stains, and their containers shall be disposed of as follows:
 1. Whenever possible containers should be thoroughly cleaned immediately after emptying and sorted with as appropriate (metal or plastic) for recycling
 2. Empty containers, regardless of type or base material, may be disposed of with lids off with general garbage.
 3. Latex paint may be placed with general garbage if properly solidified as follows:
 - a. Small amounts (an inch or less in can): Remove lids and allow paint to dry out in the can and harden. Protect cans from rain and freezing.
 - b. Large amounts (more than one inch): Mix paint with equal amounts of cat litter, stir and allow to completely dry. Alternate method: mix with commercial paint hardener.

- 4. Oil-based or combustible paints and stains, regardless of liquid or solid, shall be transported to an approved facility that takes such items such as Dane County Clean Sweep Sites.
- F. Treated Wood Materials: Treated wood materials including but not limited to wood that has been painted, stained, or chemically treated shall not be recycled or incinerated.

END OF SECTION

SECTION 01 76 00
PROTECTING INSTALLED CONSTRUCTION

PART 1 – GENERAL

1.01 SUMMARY

- A. The purpose of this specification is to provide clear responsibilities, guide lines, and requirements related to providing protection to already installed construction.
- B. Already installed construction shall include but not be limited to the following:
 - 1. Any existing site feature such as pavement, curbs, drainage features, utilities, landscaping features (trees, shrubbery, plantings, flagpoles, etc) and other such exterior items not associated with the building whether on or adjacent to the project site.
 - 2. Any existing structure on or adjacent to the project site.
 - 3. Any existing interior work that may be adjacent to the new work including all paths of ingress/egress to areas associated with accessing the Work.
 - 4. Any existing feature of any kind within the public right-of-way that may be on the project site property, adjacent to the project site or across the street from the project site.
- C. All contractors shall be familiar with the specifications of their Division of Work for specific requirements on protection of the Work.
- D. The requirements noted within this specification do not relieve any contractor of the responsibility for compliance with any code, statute, ordinance, or other such regulatory requirement having jurisdictional authority over these contract documents.

1.02 QUALITY ASSURANCE

- A. It shall be the responsibility of every contractor and worker assigned to the project to be diligent in protecting all existing work, and newly installed construction.
- B. It shall be the General Contractors' (GC) responsibility under the contract to provide all reasonable protection methods, materials, or precautionary measures required to protect new or existing construction as described in within this specification to the project as a whole.
 - 1. The GC shall be responsible to ensure any damaged new or existing construction is repaired or replaced at no additional cost to the Contract.
 - 2. The GC at their discretion may direct other contractors to provide and maintain protection of completed work associated with their Division of Work. (i.e. The carpet installer may be required by the GC to provide carpet protection along traveled paths, ingress/egress, etc after installation).
- C. It shall be the responsibility of the GC to ensure that all materials being used to protect installed construction are compatible with, and/or adjacent to, the materials being protected. This shall include but not be limited to the material used as covering, tapes used to fasten protective materials, etc.

1.03 RELATED SPECIFICATIONS

- A. Parts of this specification will reference articles within "The City of Madison FACILITIES MANAGEMENT SPECIFICATIONS for Public Works Construction".
 - 1. Use the following link to access the FACILITIES MANAGEMENT SPECIFICATIONS web page:
<http://www.cityofmadison.com/business/pw/specs.cfm>
 - a. Click on the "Part" chapter identified in the specification text. For example if the specification says "Refer to City of Madison FACILITIES MANAGEMENT SPECIFICATION 210.2" click the link for Part II, the Part II PDF will open.
 - b. Scroll through the index of Part II for specification 210.2 and click the text link which will take you to the referenced text.
 - c. City Standard Detail Drawings (SDD) may be located from the index in Part VIII.
- B. Section 01 60 00 - Product Requirements.
- C. Section 01 74 13 - Progress Cleaning.

PART 2 - PRODUCTS

2.01 FENCING MATERIALS AND BARRICADES

- A. Except where noted in other areas of the construction documents, the responsible contractor shall provide a six foot galvanized chain link fence including full height mesh screen at the project lines as shown on the Civil Drawings. For temporary barricade situations, the responsible contractor may provide one of the following that sufficiently provide a sturdy physical barrier and/or visual barrier as necessary for the intended application.
 - 1. Standard orange construction barrels each with a standard rubber base ring and reflective tape
 - a. Provide flashing amber lights as needed to increase night time visibility.
 - 2. Steel "T" style fence posts.
 - 3. 4'0" high standard orange construction fence.
 - 4. Traffic barricades.
 - 5. Jersey barriers.
 - 6. Other types of fencing or barricades typically used in the construction industry.
- B. The contractor responsible for providing the fencing materials and barricades shall also be responsible for maintaining them. This shall include but not limited to fixing damaged fencing, standing up barrels that have been knocked over, realigning barrels, and ensuring flashing lights are fully operational at all times.
- C. The following fencing and barricade designations, and their use descriptions shall be used throughout this specification to provide uniformity in describing protection requirements.
 - 1. Type A, Jersey Barriers, to be used as permanent blocking devices to deny access to alternate project site entrances or exits.
 - 2. Type B, Traffic Barricades, to be used as temporary blocking devices to deny access to alternate project site entrances or exits.
 - 3. Type C, Construction Barrels without construction fencing shall be used for lane closures, temporary blocking devices to deny access and the protection of single locations (I.E. identify the location of an access structure) that do not require fencing.
 - 4. Type D, Construction Barrels with construction fencing where it becomes necessary to surround an object with a complete visual barricade and it is impractical or unacceptable to install fence posts. The surround shall be constructed in such a manner as to provide a buffer zone around and access to the item being protected.
 - 5. Type E, Steel "T" Fence Posts shall be used at the project lines, as indicated on the Civil Drawings, with six foot galvanized chain link fencing to surround an object with a complete visual barricade and it is practical to install fence posts. The surround shall be constructed in such a manner as to provide a buffer zone around and access to the item being protected. All posts shall be driven installed. Surface mounted posts to only be used for temporary barricades.
 - 6. Type X, Other fencing or barricade types that may be designated and detailed within the construction documents shall use additional alpha numeric designations.

2.02 EROSION CONTROL PROTECTION

- A. Refer to City of Madison FACILITIES MANAGEMENT SPECIFICATION 210.2 for authorized materials associated with erosion control materials.

2.03 INTERIOR FINISH PROTECTION MATERIALS

- A. Except where noted in other areas of the construction documents or this specification the responsible contractor:
 - 1. Shall not provide the cheapest or least effective method as an effort to meet any protection requirement.
 - 2. Shall provide materials of sufficient quality, and durability to provide adequate protection based on the seasonal conditions and the anticipated duration at the time the protection will be needed.
 - 3. Shall provide sufficient quantity of protection material to protect the construction as needed.

- B. Prior to installing protective measures the responsible contractor shall propose to the GC, Project Architect /Project Engineer (A/E PROJ MGR) and City Project Manager (CPM) the proposed plan for protection, materials to be used and samples as necessary.
 - 1. The A/E PROJ MGR and CPM reserve the right to disapprove any proposed method and/or material and/or make alternate proposals.

PART 3 - EXECUTION

3.01 GENERAL EXECUTION REQUIREMENTS

- A. The GC shall be responsible for ensuring all of the following procedures and requirements are implemented as needed for the duration of the Work performed under this contract.
- B. The GC shall also be responsible for the following:
 - 1. Reporting any incident of damage to existing property, right-of-way, or utility to the CPM immediately upon rendering the incident safe, and notifying emergency response teams, and emergency utility crews as needed.
 - 2. Conduct a site walk through prior to leaving at the end of each day to assess:
- C. Protection measures are properly in place, provide correction actions as necessary.
- D. Note damage to existing completed work and schedule repair/replacement as needed.
 - 1. Ensure all contractors and workers are being diligent in protecting existing work, and newly installed construction.

3.02 PROTECT ADJACENT PROPERTIES

- A. Whenever possible through the design process the City of Madison shall have previously provided notice to adjacent property owners that work will be occurring on or near their property. The City of Madison shall also have obtained any permanent or temporary easements that may be necessary to complete any Work on adjacent properties.
- B. It shall be the responsibility of the GC to do the following for all Work under this contract being performed on or adjacent to the property line:
 - 1. Contact the adjacent property owner and provide them with information on the work to be done, equipment to be used, and estimated duration of the work. Information to be updated and communicated to property owner(s) as construction progresses and site conditions change.
 - a. If any adjacent property is a rented or leased space the GC shall also make contact and provide the same information to the tenants.
 - b. Determine from the owner and/or tenants if there are any concerns for children, pets, special plantings, or other concerns.
 - 2. Discuss the following with all contractors performing work on or near the property line.
 - a. Work to be completed and timeline.
 - b. Concerns of adjacent property owners/tenants from item 1 above.
 - c. Which protective measures will be necessary to protect adjacent properties and address the concerns of adjacent property owners/tenants.
 - 3. Ensure all protective measures are placed and maintained during the execution of Work on or adjacent to the property line. Interact with the adjacent property owners/tenants as needed.
- C. Any contractor doing work on or adjacent to the property line shall install and maintain any protective measure identified in the contract documents, this specification, or as directed by the GC.
- D. The GC shall be responsible for restoring any damage to structure and property located on or adjacent to the property line.
 - 1. Restoration shall include but not be limited to repair or replacement using like materials and finishes to its original condition or better.
 - 2. Restoration of landscaping materials shall include watering of any seed, sod, or other planting of any kind for a reasonable period of time to encourage germination and root development.

- E. The GC shall keep the CPM informed directly to any issues pertaining to adjacent property owners and tenants.

3.03 PROTECT LANDSCAPING FEATURES

- A. Except where specifically stated in other areas of the construction documents the following minimal protection requirements shall apply under this section.
 - 1. Whenever possible do not install new landscape features until exterior building construction has been completed, equipment such as scaffolding and lifts are no longer needed and have been removed, and heavy equipment operation is no longer required.
 - 2. Whenever possible remove and temporarily store all existing landscape features such as benches, waste receptacles, signage, and other such features that will be within the area of Work that can be removed.
 - 3. Landscape features that cannot be removed such as flag poles, light poles, light bollards, etc. shall be protected with Type D fencing for areas on pavement or Type E fencing for areas on soil.
 - 4. Planting beds shall be protected using Type E fencing around the exposed perimeter of the planting bed as needed.
 - 5. The City of Madison FACILITIES MANAGEMENT SPECIFICATION 107.13 shall apply to all tree protection in and around the project site at all times.

3.04 PROTECT UTILITIES

- A. The contractor shall be responsible for notifying all utilities to determine emergency response procedures and protection requirements prior to installing any construction protection.
 - 1. This includes requesting utility marking through Diggers Hotline.
- B. Call 811 or 1-800-242-8511 to request a public utility locate.
- C. For emergency locate call (262) 432-7910 or (877) 500-9592
 - 1. Contact the Owner and CPM for any available private utility information on the property that may be available prior to calling a private utility locating company.
- D. Except where specifically stated in other areas of the construction documents the following minimal protection requirements shall apply under this section.
 - 1. Hydrants, lamp posts, electrical transformers, and other utility pedestals shall be protected with Type D fencing for areas on pavement or Type E fencing for areas on soil. Fence posts shall be located so as to not be directly over the utility main.
 - 2. Storm sewer structures in pavement shall have proper inlet protection according to City of Madison FACILITIES MANAGEMENT SPECIFICATION 210.1(g) and Type C Construction Barrels when necessary.
 - 3. Storm sewer structures in turf and other landscaped areas shall have proper inlet protection according to City of Madison FACILITIES MANAGEMENT SPECIFICATION 210.1(g) and Type E fencing for areas on soil.
 - 4. Stormwater management features such as greenways, retention/detention ponds, bio-filtration ponds and other such features shall be properly protected according to the appropriate erosion control measure specified on the Erosion Control Plan. See multiple sections of City of Madison FACILITIES MANAGEMENT SPECIFICATION 210.1
 - a. For the protection of hard to see items such as structures, castings, inlets, etc. in grassy areas provide Type E fencing for areas on soil.
 - b. For the protection of storm water management features having special soils and plants such as bio-filtration ponds provide Type E fencing for areas on soil.
 - 5. Other structures and covers including but not limited to cleanouts, wiring hand holes, valve boxes, access structures, grease trap structures, etc shall be protected as follows:
 - a. Provide Type E fencing for areas on soil.
 - b. When paving operations are complete provide a construction barrel or cone near structures as necessary depending on required heavy construction traffic.

3.05 PROTECT PUBLIC RIGHT OF WAY

- A. Except where specifically stated in other areas of the construction documents the following minimal protection requirements shall apply under this section.
 - 1. All public right-of-way (area from behind the sidewalk to the centerline of the street) shall remain open and accessible except during periods of active work. At such times the public right of way shall be properly closed and signed as referenced in City of Madison FACILITIES MANAGEMENT SPECIFICATION 107.9.
 - 2. Bus stops and bus stop structures shall remain accessible at all times.
 - 3. Traffic signage and traffic signals, traffic control boxes shall be protected with Type D fencing for areas on pavement or Type E fencing for areas on soil.
 - a. Protection at traffic signage/signals shall not obstruct the viewing of the sign/signal for its intended purpose at any time.
- B. When additional protection for traffic control is required, the use of barricades, guardrails, lane closures and other such procedures will be detailed within the construction documents.
- C. When additional protection for overhead sidewalk cover is required the contract documents shall indicate the specific location and structural requirements of the protective structure.

3.06 PROTECT STORED MATERIALS

- A. All contractors shall refer to Specification 01 60 00 Product Requirements for all storage and protection requirements of building materials and products delivered to the site.

3.07 PROTECT WORK - EXTERIOR

- A. Provide all temporary services that may be required to protect the installed material from heat, cold, humidity, etc, while materials such as concrete, mortar, sealants, paints, etc, are drying and/or curing.
- B. Open trenches, pits, and other such excavations shall be properly covered, lined, or shored as needed during periods of inclement weather to prevent the caving of soils onto existing work in progress. Refer to the appropriate specifications and/or regulatory requirements governing this type of work as necessary.
- C. Provide adequate protection at all openings with heavy duty tarps, plastic sheathing, or wood framing and sheathing as needed to protect interior work in progress from inclement weather as needed.
- D. Protect exterior finishes of all kinds with heavy duty tarps or plastic sheathing as needed while landscaping is being installed through full germination of seeded areas or installation of filter fabric and mulches to keep dust, dirt, and mud off of finished exterior surfaces.
- E. Designate specific curb mounting points and provide wood blocking where small vehicles, skid loaders and other such equipment may need access to areas being landscaped.
- F. Provide plywood turning pads for skid loaders to turn on to prevent tire marking on new pavement.
- G. Do not permit the parking of vehicles with any kind of fluid leaks to park on new pavement.
- H. The contractor shall be responsible for cleaning, repairing, or replacing any completed work or work in progress under this specification as deemed necessary by the CPM without additional cost to the contract.

3.08 PROTECT WORK - INTERIOR

- A. The GC shall do all of the following:
 - 1. Provide all temporary services that may be required to protect the installed material from heat, cold, humidity, etc, while materials such as concrete, mortar, sealants, paints, etc, are drying and/or curing.
 - 2. Provide adequate visual and/or physical protection as needed to protect newly completed interior work such as paint, flooring material, sealants, grouts, etc that may be drying and/or curing.
 - 3. Provide adequate space and materials for cleaning boots, tool boxes, supplies, and other items coming into the project site once finish work has begun.

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4. Clean dirtied areas and repair/replace damaged areas immediately.
- B. The contractors responsible for interior work shall be responsible for protecting their work and finishes from dirt, mud, snow, spills, splatters, and physical damage after installation as follows:
1. Protect vinyl composite, rubber composite, painted/stained concrete, and tiled flooring as follows:
 - a. Define foot traffic areas and protect with Ramboard Temporary Floor Protection products as a minimum basis of design or other protection product(s) compatible with installed flooring product if Ramboard is not compatible. Products to be used shall be new.
 2. Tape all edges, seams, etc with a good quality tape that does not leave sticky residue. Do not allow any debris or other material between the installed flooring and the protection material.
 - 1) Repair tears immediately, replace worn areas with like material as necessary.
 3. Protect carpeted areas as follows:
 - a. Define foot traffic areas and protect with a minimum of 6mil, clear, polyethylene sheeting 3 feet (91.44 cm) wide. Products to be used shall be new.
 - 1) Tape all edges, seams, etc with a good quality tape that does not leave sticky residue. Do not allow any debris or other material between the installed flooring and the protection material.
 - 2) Repair tears immediately, replace worn areas with like materials as necessary.
 4. Protect all finished walls in high traffic areas with Ramboard Temporary Wall protection products or approved equal.
 - a. Tape all edges, seams, etc with a good quality tape that does not leave sticky residue. Do not allow any debris or other material between the installed flooring and the protection material.
 - b. Repair tears immediately, replace worn areas with like materials as necessary.
 5. Protect counter tops, cabinets, and other finished surfaces with large sheets of thick cardboard or Ramboard products. Do not allow toolboxes, finish materials, parts and other such items to be placed on finished materials.
- C. All protection shall stay in place until the CPM, PA/PE, and GC mutually deem the project is ready for Final Cleaning. The contractors responsible for protecting the work shall be responsible for removing the protection and removing any adhesive residue at that time. Contractors shall only use manufacturer authorized cleaning materials for removing adhesives, etc.
- D. Contractors doing work in un-protected areas of finished work shall be required to provide drop cloths and other protection as noted within this specification for the duration of their work.
1. Finished areas shall be sufficiently covered to accommodate all equipment, and materials being used to complete the work being done.
 2. Finished areas shall be sufficiently covered to prevent splatters, over spray, etc when doing touch-up work.
 3. Contractors who do not provide sufficient protection under this sub-section shall be responsible for any costs associated with cleaning, repairing or replacing already finished construction at no additional cost to the contract.

END OF SECTION

**SECTION 01 77 00
CLOSEOUT PROCEDURES**

PART 1 – GENERAL

1.01 SUMMARY

- A. The purpose of this specification is to clearly define and quantify the requirements associated with closing a City of Madison Public Works Contract for facility related work.
- B. All contracts have two distinct but related paths. Each path needs to be properly closed independently in order to close the contract as a whole.
 - 1. Construction closeout is related to closing out all of the Work associated with the construction documents.
 - a. It shall be the responsibility of all contractors to be fully aware of the required Work and closeout requirements involved in their individual trades.
 - 2. Contract closeout is related to closing out all of the administrative aspects of the contract in general.
 - a. It shall be the responsibility of all contractors to be fully aware of the administrative requirements required by the contract and to provide the supporting documentation required.
 - 3. Construction Closeout must be completed before Contract Closeout can begin.
- C. This specification will provide general knowledge associated with the following areas:
 - 1. Construction Closeout Requirements.
 - 2. Construction Closeout Procedure.
 - 3. Contract Closeout Requirements.
 - 4. Contract Closeout Procedure.
 - 5. Final Payment and Certificate of Completion.

1.02 RELATED SPECIFICATIONS

- A. Contractors shall review all references to other specifications including specifications relating to the execution of the Work associated with their Division or Trade.
- B. Section 01 29 76 - Progress Payment Procedures.
- C. Section 01 31 23 - Project Management Web Site.
- D. Section 01 32 26 - Construction Progress Reporting.
- E. Section 01 45 16 - Field Quality Control Procedures.
- F. Section 01 74 13 - Progress Cleaning.
- G. Section 01 45 16 - Construction Waste Management and Disposal.
- H. Section 01 76 00 - Protecting Installed Construction.
- I. Section 01 78 13 -Completion and Correction List.
- J. Section 01 78 23 - Operation and Maintenance Data.
- K. Section 01 78 36 - Warranties.
- L. Section 01 78 39 - As-Built Drawings.
- M. Section 01 78 43 - Spare Parts and Extra Materials.
- N. Section 01 79 00 - Demonstration and Training.
- O. Section 01 91 00 - Commissioning.
- P. Other requirements as noted in the contract documents signed by the General Contractor.

1.03 DEFINITIONS

- A. Substantial Compliance: A letter provided to the City of Madison Building Inspection and signed by the Project Architect indicating that all Work has been completed to a level that would allow Owner Occupancy and that all construction is in compliance with the construction documents. A copy of this letter is also provided to the State of Wisconsin Department of Health and Safety as necessary to clear plan review requirements. This letter does not represent construction closeout.
- B. Certificate of Occupancy: The Regulatory letter from the City of Madison Building Inspection Department indicating that all regulatory requirements and inspections have been completed and the building may now be occupied for its intended use. This letter does not represent construction closeout.
- C. Certificate of Substantial Completion: A letter provided by the Department of Public Works, signed by the City Engineer indicating that Construction activities are substantially complete. This letter does represent construction closeout and the date of this letter begins the date of the Warranty Period.
- D. Construction Closeout: The point in the contract where all contractual requirements associated the execution of the Work as described in the plans, specifications, and other documents have been successfully met and the items described in 1.3.A, .B, and .C above have been completed.
- E. Final Progress Payment: The progress payment associated with achieving Construction closeout as described in 1.3.D above. At this point the contractor may request all monies associated with the contract be paid with the exception of held retainage.
- F. Contract Closeout: The point in the contract where all contractual requirements associated with the City of Madison, Board of Public Works contract has been successfully met.
- G. Final Payment: The final contract payment submittal that may be approved by the City of Madison after all contractual requirements of the Public Works Contract have been met and any remaining monies (retainage) due to the contractor may be released for the Final Payment.

1.04 QUALITY ASSURANCE – CONSTRUCTION CLOSEOUT

- A. All contractors shall be responsible for properly executing the construction closeout requirements associated with their Work as described in the specifications governing their Work.
- B. The GC shall be responsible for all of the following:
 - 1. Ensuring that all contractors have met the construction closeout requirements associated with their Work.
 - 2. Coordinate the collection of all construction closeout deliverables from all contractors, provide the deliverables to the Project Architect and City Project Manager for review as necessary, and ensure all contractors correct deficiencies of deliverables and resubmit as needed for final acceptance.
 - 3. Ensure all closeout requirements identified in the Construction Closeout Checklist below have been completed as intended by the construction documents.

1.05 QUALITY ASSURANCE – CONTRACT CLOSEOUT

- A. The City of Madison, Department of Civil Rights (DCR) monitors contract compliance for construction and procurement contracts to ensure that local, state and federal regulations are followed by contractors working on City of Madison Public Works (PW) projects. DCR will monitor all PW projects from contract award through the final payment at the close of the project. Contractors will be required to submit reporting paperwork throughout the PW project process.
 - 1. Contractors are encouraged to visit the web site identified below for additional information, checklists, forms, and other information provided by DCR as it relates to Contract Compliance.
<http://www.cityofmadison.com/Business/PW/contractCompliance.cfm>

2. Questions regarding the process should be directed to parties and offices as identified on the various forms, documents, and instructions or contact:
 City of Madison, Department of Civil Rights
 210 Martin Luther King Jr. Blvd., Room 523, Madison, WI 53703
 (608) 266-4910
- B. All Sub-Contractors have submitted the applicable required documents described in item 1.5.D below to the General Contractor (GC) for Contract Closeout.
- C. The GC has submitted the required applicable documents described in item 1.5.D below for all contractors to the appropriate City of Madison Agency per instructions associated with each submittal.
- D. The documents required for submittal to the City of Madison for Contract Closeout may include any/all of the items listed below depending on contract type. It is the sole responsibility of all contractors to know and submit the required and complete documentation in a timely fashion.
 1. Weekly Payroll Reports.
 2. Employee Utilization Reports.
 3. Documentation required for Small Business Enterprise (SBE) goals.
 4. Other documents as maybe required or requested through the Finalization Review Process.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.01 CONSTRUCTION CLOSEOUT CHECKLIST

- A. All contractors shall be responsible for reviewing the drawings and specifications within their Divisions of Work to provide a complete and comprehensive list of all Construction Closeout Requirements to the GC.
 1. The checklist shall include all items identified within the construction documents that require any of the following (and examples) prior to moving into Contract Closeout Procedures:
 - a. Documents indicating a specified level of performance has been achieved, such as:
 - 1) Test reports of all types.
 - 2) Startup reports.
 - b. Required documentation, such as:
 - 1) As-builts and record drawings.
 - 2) Operation and maintenance data.
 - c. Physical items to be turned over to the owner, such as:
 - 1) Attic stock.
 - 2) Keys.
 - d. Required maintenance completed, such as:
 - 1) Ducts cleaned.
 - 2) Filters replaced.
 - e. Commissioning and LEED related items and submittals.
 - f. Owner and Maintenance Training.
- B. Each list shall indicate the title of the closeout requirement, the associated specification of the requirement, the required result or deliverable, the responsible contractor(s), and a column to verify the item has been turned in and completed.
- C. The GC shall be responsible for all of the following:
 1. Consolidating all the closeout lists into one master Construction Closeout Checklist.
 - a. The checklist shall be in a tabular data format similar to the sample below
 2. Upload the completed checklist to the Project Management Web Site for review.
 3. Resubmit the checklist as needed after initial reviews have been completed.

- D. The GC shall work with all contractors to amend the Construction Closeout Checklist throughout the execution of the project based on changes and modifications as necessary.

Title	Specification	Description	Responsibility	Completed
Quality Management Observation Reports	01 45 16	All QMO reports have been properly responded to, reviewed and closed by the CPM.	All, GC	
As-Built Drawings	01 78 39	As-Built drawings have been reviewed and accepted per the specification	All, GC	
Testing and Balancing of HVAC	23 09 23	Provide final TnB reports indicating design performance has been achieved	HVAC	

3.02 CONSTRUCTION CLOSEOUT REQUIREMENTS

- A. The timely submittal or completion of closeout requirements shall go hand in hand with the Progress Payment Milestone Schedule that can be found in Specification 01 29 76 Progress Payments. No payments shall be made until all requirements for that payment have been met.
1. The GC and all major Subcontractors, Project Architect /Project Engineer/A/E PROJ MGR, and CPM, shall review all requirements for Construction/Contract Closeout during two (2) special meetings.
 - a. The first meeting shall be held at the 50% Contract Total Payment milestone. This meeting shall discuss the requirements associated with various construction/contract closeout documentation and events when they are due with respect to progress payments.
 - b. The second meeting shall be held at the 70% Contract Total Payment milestone. This meeting shall review the contractors progress regarding the closeout checklist, begin making plans for upcoming deadlines such as scheduling training, where to put attic stock, and when they are due with respect to progress payments.
 2. The GC, A/E PROJ MGR, and CPM, shall utilize the Construction Closeout checklist to ensure that all construction closeout requirements have been met.

3.03 CONSTRUCTION CLOSEOUT PROCEDURE

- A. Upon successful completion and final acceptance of all Construction Closeout Requirements the GC may submit to the CPM and A/E PROJ MGR the request for Final Progress Payment (100% contract total, less retainage).
- B. The A/E PROJ MGR will confirm with the design consultants, CPM, and other City of Madison staff that all requirements of the Work have been completed and will do the following:
1. Approve the final progress payment application.
 2. Provide the required signed payment documents to the CPM.
 3. Provide the required Letter of Substantial Compliance to the following as required:
 - a. State Safety and Building Division.
 - b. Local Building Inspection office.
 - c. GC.
 - d. CPM.
- C. The CPM shall draft the City Letter of Substantial Completion for signature by the City Engineer. This letter shall state any of the following that may still be tied to the contract and/or warranty:
1. Indicate that the date of the letter shall also be the beginning of the Warranty period.

2. Indicate any allowed due outs, reasons for them, and anticipated dates of finalization.
 - a. QMO issues such as off season testing of equipment.
 - b. Off season training of equipment.
- D. The GC and all subcontractors shall finalize all warranty letters associated with their Work using the date noted on the City Letter of Substantial Completion, and provide the CPM with all warranties as described in Specification 01 78 36 - Warranties. Upon receipt and final approval of the Warranties the CPM may initiate final processing of the Final Progress Payment (100% contract total, less retainage).

3.04 CONTRACT CLOSEOUT REQUIREMENTS

- A. The GC and all sub-contractors shall follow all requirements associated with documenting contract compliance and provide documentation as required or requested by DCR or PW staff. All contractors are encouraged to stay current with submissions of the following documentation:
 1. Weekly Payroll Reports no later than the Progress Payment equal to 50% of the contract total.
 2. Employee Utilization Reports.
 3. Agent or Subcontractor Affidavit of Compliance with Prevailing Wage Rate Determination.
 4. Prime Contractor Affidavit of Compliance with Prevailing Wage Rate Determination.
 5. Documentation required for Small Business Enterprise (SBE) goals.
 6. Other documents as maybe required or requested through the Finalization Review Process.
- B. Near the Progress Payment equal to 80% of the contract total the GC shall request in writing a Finalization Review. At that time DCR or PW staff shall prepare a report of all contract documentation submitted to date. A list of missing items or outstanding issues will be emailed to the GC. No additional follow-up will be generated by DCR or PW Staff.

3.05 CONTRACT CLOSEOUT PROCEDURE

- A. The Contract Closeout Procedure will not begin until the Construction Closeout Procedure has been completed.
- B. When the GC feels they have successfully met all of the Contract Closeout Requirements associated with Section 3.03 above the GC may submit to the request for Final Payment to the CPM.
- C. The CPM shall sign and submit the Final Payment request for processing.
- D. DCR and PW staff shall do a complete review of all documentation associated with item 3.03.A above.
- E. The GC shall be notified directly by DCR or PW Staff of any documentation that may still be missing, have incomplete information, or other outstanding issues. It shall be the responsibility of the GC to continue follow-up with DCR and PW staff until all documentation has been successfully submitted and accepted.
- F. When all required documentation associated with Contract Closeout has been successfully submitted and accepted by DCR and PW Staff the City of Madison shall process the Final Payment of any remaining monies including retainage.

END OF SECTION

**SECTION 01 78 13
COMPLETION AND CORRECTION LIST**

PART 1 – GENERAL

1.01 SUMMARY

- A. The City of Madison (CoM) has developed a multi-faceted Quality Management Program that begins with contract signing and runs through contract closeout to ensure the best quality materials, workmanship, and product are delivered for the contracted Work.
 - 1. The Project Management Web Site (PMWS) is a Construction Management tool that provides contractors, consultants, and staff a single on-line location for the daily operations and progression of the Work.
 - 2. The Quality Management Observation (QMO) is an ongoing observation of the construction process as it progresses. The City of Madison does not use a "Punch List" or "Corrections List" as it is typically known throughout the construction industry. The QMO process acts as an "in progress punch list". Work identified as not in compliance with the contract documents by the Owner, Owner Representatives, Owner Consultants, etc. shall be resolved immediately at the Contractor's expense. Unresolved issues will be subject to withholding of progress payment(s) until completed.
 - 3. Very stringent expectations are tied to Construction Closeout and Contract Closeout procedures. Specific milestones throughout the project need to be met and the milestones are tied to the Progress Payment Schedule.
- B. All contractors shall be required to review the specifications identified in Section 1.02 below, and other related specifications identified therein to become familiar with the terminology and expectations of this City of Madison Public Works contract.

1.02 RELATED SPECIFICATIONS

- A. Section 01 29 76 - Progress Payment Procedures.
- B. Section 01 31 23 - Management Web Site.
- C. Section 01 45 16 - Field Quality Control Procedures.
- D. Section 01 77 00 - Closeout Procedures.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 – EXECUTION – THIS SECTION NOT USED

END OF SECTION

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 – GENERAL

1.01 SUMMARY

- A. The purpose of this specification is to provide clear responsibilities and guide lines related to providing well documented and complete Operation and Maintenance (O&M) Data related to general facility use, equipment, systems, finishes, and materials to City of Madison Staff (Owner, Owner Representatives, Maintenance, and Custodial Personnel) as needed.
- B. Operation and Maintenance Data shall apply to both of the following categories except where specific requirements are noted under their separate titles as follows:
 - 1. Operation and Maintenance Data: Generally shall mean the owner manual that provides information on start-up, shut-down, operation, troubleshooting, maintenance, parts, and other such documentation as it pertains to all equipment and systems installed under the Work.
 - 2. Use and Care instructions: Where applicable use and care instructions shall also be considered O&M for such things as flooring, tile, partitions, and other such finishes and trim related items, installed under the Work.

1.02 RELATED SPECIFICATIONS

- A. Section 01 29 76 - Progress Payment Procedures.
- B. Section 01 31 23 - Project Management Web Site.
- C. Section 01 77 00 - Closeout Procedures.
- D. Section 01 78 13 - Completion and Correction List.
- E. Section 01 78 19 - Maintenance Contracts.
- F. Section 01 78 36 - Warranties.
- G. Section 01 79 00 - Demonstration and Training.
- H. Section 01 91 00 - Commissioning.
- I. Other Divisions and Specifications that may address more specifically the requirements for O&M Data.

1.03 QUALITY ASSURANCE

- A. All O&M Data shall meet the requirements identified in Section 1.4 below.
- B. All contractors shall provide O&M Data for each piece of equipment, system, or finish installed during the installation of the Work. O&M Data shall be provided to the General Contractor (GC) for verification and submittal.
- C. The GC shall be responsible for receiving all required O&M Data files from all contractors for verifying that all files submitted meet the requirements in Section 1.4 below.

1.04 O&M DATA REQUIREMENTS

- A. O&M Data shall be provided in digital PDF format as follows:
 - 1. PDF files shall be complete first generation consumer useable editions of PDF documents as provided by any of the following:
 - a. Product manufacturer.
 - b. Supplier of product.
 - c. Product manufacturer internet site.
 - 2. Acceptable PDF files shall have the following functionality:
 - a. Word searchable.
 - b. Key areas are bookmarked.
 - c. Table of Contents and/or Index linked to content is preferred whenever possible.

3. Scanned printed material, with word searchable capabilities, saved as a PDF, is not acceptable and will be rejected without further review.
- B. O&M Data shall include but not be limited to the following manufacturers' published information as appropriate for the equipment, system, material, or finish:
 1. Installation instructions.
 2. Parts lists, assembly diagrams, explosion diagrams.
 3. Wiring diagrams.
 4. Start-up, shut-down, troubleshooting and other related operation procedures.
 5. Lubrication, testing, parts replacement, and other such maintenance procedures.
 6. General use, care, and cleaning instructions.
 7. Special precautions and safety requirements.
 8. A list of certified equipment vendors, service companies, parts suppliers including company name, address, and phone number.
 9. A list of the recommended spare parts to have on hand at all times.
 10. A list by type of all recommended lubes, oils, packing material, and other maintenance supplies.
 11. Copies of final test reports, balance reports, and other related documentation.
 12. Warranty information for equipment and systems.

1.05 O&M DATA SUBMITTALS

- A. O&M Data shall be prepared as identified in this specification and shall be submitted for review as per the schedule identified in Specification Section 01 29 76 - Progress Payment Procedures.
- B. O&M Data Draft submittals will be reviewed for content, procedure, and compliance only. A general critique with recommendations for improvement will be made but re-submittals will not be required.
- C. O&M Data Final submittals will be reviewed for content, procedure, and compliance. Re-submittals will be required until such time as each submittal is accepted.
- D. NOTE: Acceptance of O&M Data Final submittals is required to be complete prior to scheduling and conducting owner related training and construction closeout.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.01 O&M DATA PREPARATION - GENERAL

- A. All contractors shall prepare O&M Data for draft and final submission as follows:
 1. Obtain digital PDF files for each piece of equipment, system, material or finish as described in Sections 1.04.A.1 and 1.04.A.2 above.
 2. Verify that all information as described in Section 1.04.B above is included with the PDF file. Obtain missing information as necessary for a complete submittal.
- B. Rename each individual PDF file as follows.
 1. Do not use special characters such as #, %, &, /, etc. These characters are reserved by the Project Management Web Site software the City of Madison uses; however the under-score (or under-bar) '_' is an allowed character.
 2. Use the following format and examples for renaming your file:
 - a. Format: Equipment name_What_IMAGINATION CENTER AT REINDAHL PARK_Contract number_Year
 - 1) "Equipment Name" represents the name of any equipment, system, material or finish as designated in the Contract Documents.
 - 2) "What" represents what the file is about.
 - 3) IMAGINATION CENTER AT REINDAHL PARK represents the title of the project or contract. A shortened version of the title may be identified by the City Project Manager to be used by all contractors.
 - 4) "Contract number" is the specific identification number the Work was bid under and appears on the plan set title sheet and in each sheet title block.

- 5) "Year" represents the year the contract will be closed out.
- b. Examples of file names
 - 1) AHU 2_Operation Manual_Fire Admin_1234_2015.
 - 2) CPT 2_Use and Care_MPD West_9876_2011.
- C. All contractors shall submit the completed digital PDF files to the GC in sufficient time for the GC to meet the O&M Data submission deadlines as described in Specification Section 01 29 76, Progress Payment Procedures.
- D. O&M Data shall be submitted and reviewed as described in sections 3.02 and 3.03 below.

3.02 O&M DATA DRAFT SUBMITTAL

- A. All contractors shall prepare and submit the following for an O&M Data Draft review submittal:
 1. Prepare three (3) complete O&M Data file samples as described in section 3.01 above.
 2. Review all specifications within their Division of Work and prepare a complete O&M Data checklist listing all equipment, systems, materials, or finishes. Checklist shall be in tabular form similar to the example below and shall indicate the title (and plan identifier when applicable) of the O&M Data, the associated specification, and a column to verify the item has been turned in and completed.
- B. The GC shall be required to review all contractors' samples and checklists for compliance with this specification and shall return any to the originating contractor that are insufficient for re-submittal.
 1. When acceptable to the GC, they shall upload each O&M Data draft submittal file to the O&M Draft library on the Project Management Web Site.
- C. The Project Architect, City Project Manager, CxA, Consulting Staffs and Owner Representatives shall review the O&M Data draft submittals and checklist within fifteen 15 working days as follows:
 1. Provide general critique comments by Division on O&M Data samples submitted. Critique is intended to provide all contractors with information on strengths and weaknesses of their submittals.
 - a. Re-submittal of the O&M Data samples will not be required.
 2. Review in detail the O&M Data Checklist for completeness. Provide comments as needed.
 - a. Re-submittal of the O&M Checklist will be required until accepted.

Title	Specification	Completed
Overhead Door Operator	08 36 00	
Air Handling Unit (AHU-3)	23 00 00	
Water Heater (WH-1)	22 30 00	

3.03 O&M DATA FINAL SUBMITTAL

- A. All contractors shall prepare and submit the following for an O&M Data Final review submittal:
 1. Prepare complete O&M Data files as described in Section 3.01 above according to their approved checklist as described in Section 3.02 above.
 2. Submit completed checklist and all final O&M Data files to the GC for final submittal review.
- B. The GC shall be required to spot check all contractors' submittals for completeness against their checklists and for compliance with this specification and shall return any to the originating contractor that are insufficient for re-submittal.
 1. When acceptable to the GC, they shall upload each O&M Data final submittal file to the O&M Final library on the Project Management Web Site.
- C. The Project Architect, City Project Manager, CxA, Consulting Staffs and Owner Representatives shall review the O&M Data final submittals and checklist within fifteen (15) working days as follows:
 1. Review the files submitted against the checklist and request any missing files through the GC.
 2. Review in detail all of the O&M Data files for completeness.

- a. Submittals shall be accepted or rejected as individual PDF files.
- b. Contractors shall re-submit entire O&M submittal if any portion is rejected or incomplete.

3.04 CONSTRUCTION CLOSEOUT

- A. All contractors shall review Specification 01 77 00 - Closeout Procedures and Specification 01 79 00 - Demonstration and Training.
 - 1. Acceptance of all final O&M Data submittals is required prior to scheduling Demonstration and Training Sessions.
 - 2. Completion of all Demonstration and Training Sessions is required to receive the Substantial Compliance for Occupancy Certificate, and to begin Construction Closeout procedures.

END OF SECTION

SECTION 01 78 36 WARRANTIES

PART 1 – GENERAL

1.01 SUMMARY

- A. The purpose of this specification is to provide clear responsibilities and guide lines related to providing all Warranties and Guarantees related to the Work, workmanship, materials, equipment, and other such items required by the Construction Documents.
- B. Manufacturers' disclaimers and limitations on product warranties do not relieve any contractor of the warranty on the Work that includes the product.
- C. Manufacturers' disclaimers and limitations on product warranties do not relieve suppliers, manufacturers and any contractor required to provide special warranties under the contract documents.

1.02 RELATED SPECIFICATIONS

- A. Section 01 29 76 - Progress Payment Procedures.
- B. Section 01 31 23 - Project Management Web Site.
- C. Section 01 77 00 - Closeout Procedures.
- D. Section 01 78 23 - Operation and Maintenance Data.
- E. Section 01 91 00 - Commissioning.
- F. Other Divisions and Specifications that may address more specifically the requirements for Warranties related to the installation of all items and equipment installed under the execution of the Work.

1.03 DEFINITIONS

- A. See specification 01 77 00 - Closeout Procedures for the definitions of the following terms that may also be used in this specification:
 - 1. Substantial Compliance.
 - 2. Certificate of Occupancy.
 - 3. Certificate of Substantial Completion.
 - 4. Construction Closeout.
 - 5. Contract Closeout.
- B. Emergency Repair: The Owner or Owner Representative reserves the right to make emergency repairs as required to keep equipment or materials in operation or to prevent damage to property and injury to persons without voiding the contractors warranty or bond or relieving the contractor of their responsibilities during the warranty period.
- C. Installer: The company or contractor hired to install a finished product that was manufactured and supplied specifically for the Work within this contract. The Installer may or may not be the same company that supplied the product. See the definition for supplier.
- D. Supplier: Any company that makes a specific finished product for the Work from information within the Contract Documents. Examples of suppliers would include custom cabinets, steel stairs and railings, etc. A supplier would not be a company that distributes items manufactured by others such as an electrical or plumbing supplier.
- E. Warranty: A written guarantee from the manufacturer to the owner on the integrity of a product and its installation, and the manufacturers' responsibility to repair or replace the defective product or components within a specified time from the date of ownership. Warranty may also be used interchangeably with Guarantee. The following warranty types may be part of any specification within the Work associated with the Construction Documents:
 - 1. Expressed Warranty: A warranty that provides specific repair or replacement for covered components of a product over a specified length of time.

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2. Implied Warranty: A warranty that is not stated explicitly by a seller or manufacturer that the product is merchantable and fit for the intended purpose.
 3. Standard Product Warranty: Preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner. Standard warranties may be for any amount of time but shall not be for anything less than one (1) year from the warranty date.
 4. Special Warranty: A written warranty required by the Contract Documents either to extend the time limit provided under a standard warranty or to provide greater rights to the Owner.
- F. Warranty Date: The effective date that begins all warranty periods required for products, installations, and work-manship associated with the execution of the Work for this contract. The Warranty Date shall be set by the CPM.
- G. Related Damages and Losses: When correcting failed or damaged Warranted Work, remove and reinstall (or replace if necessary) the construction that has been damaged as a result of the failure or the construction that must be removed and replaced to obtain access for the correction of Warranted Work.
- H. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected reinstate the warranty by a new written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation unless specifically noted otherwise in a specification.
- I. Replacement Cost: All costs that may be associated with Work being replaced under warranty including but not limited to the following:
1. Related damages and losses.
 2. Labor, material and equipment.
 3. Permits and inspection fees.
 4. This shall be regardless of any benefit the Owner may have had from the Work through any portion of its anticipated useful service life.
- J. Replacement Work: All materials, products, required labor, and equipment necessary to replace failed or damaged warranted to an acceptable condition that complies with the requirements of the original Construction Documents.
- K. Owners Recourse: Expressed warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Owner can enforce such other duties, obligations, rights, and remedies.
1. Rejection of Warranties: The Owner reserves the right to reject any warranty and to limit the selection of products with warranties not in conflict with the requirements of the contract documents.
 2. Where the Contract Documents require a Special Warranty or similar commitment on the Work or product, the Owner reserves the right to refuse acceptance of the Work until the Contractor presents evidence the entities required to countersign such required commitments have done so.

1.04 GENERAL CONTRACTORS RESPONSIBILITIES

- A. The General Contractor (GC) shall be responsible to remedy, at their expense, any defect in the Work and any damage to City owned or controlled real or personal property when the damage is a result of:
1. The GC's failure to conform to Contract Document requirements.
 - a. Any substitutions not properly approved and authorized may be considered defective.
 2. Any defect in workmanship, materials, equipment, or design furnished by the GC or Sub-contractors.
- B. All warranties as described in this specification and these Contract Documents shall take effect on the date established by the CPM, as noted in Section 1.3F above.
1. All warranties shall remain in effect for one (1) year thereafter unless specifically stated otherwise in the Contract Documents or where standard manufacturer warranties are greater.
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- C. The GC's warranty with respect to Work repaired or replaced, including restored or replaced Work due to damage, will run for one (1) year from the date of Owner Acceptance of said repair or replacement.
 - 1. This shall be regardless of any benefit the Owner may have had from the Work through any portion of its anticipated useful service life.
- D. Warranty Response
 - 1. See Section 3.05 of this specification.

PART 2 – PRODUCTS - THIS SECTION NOT USED

PART 3 - EXECUTION

3.01 WARRANTY CHECKLIST

- A. All contractors shall be responsible for reviewing the drawings and specifications within their Divisions of Work to provide a complete and comprehensive list of all Warranty Requirements to the GC.
- B. Each list shall indicate the title (and plan identifier when applicable) of the warranted item, the associated specification of the warranted item, the terms of the warranty (years), and a column to verify the item has been turned in and completed.
- C. The GC shall be responsible for all of the following:
 - 1. Consolidating all the warranty lists into one master Warranty Checklist.
 - a. The checklist shall be in a tabular data format similar to the sample below.
 - 2. Upload the completed checklist to the Submittal Library on the Project Management Web Site for review. See Specification 01 33 23 Submittals for more information on this procedure.
 - 3. Resubmit the schedule as needed after initial reviews have been completed.
- D. The GC shall work with all contractors to amend the Warranty Checklist throughout the execution of the project based on changes and modifications as necessary.

Title	Specification	Terms	Completed
Overhead Door Operator	08 36 00	MFR 2yr	
Exterior Bench and Trash Receptacles	12 93 00	MFR 3 year warranty on finish	
Kitchen Sink (SK-1)	22 42 00	MFR 5 year	
Disposal (D-1)	22 42 00	MFR 7 year parts and in-home service	
Toilet (WC-1)	22 42 00	MFR 1 year limited	

3.02 LETTERS OF WARRANTY

- A. All letters of warranty shall be in a typed letter format and provide the following information:
 - 1. The letter shall be on official company stationary including company name, address, and phone number.
 - 2. Indicate project name, contract number, and contract address the warranty is for on the reference line.
 - 3. Provide a description of the warranty(ies) being provided.
 - a. Include Division, Trade, or Specification information as necessary.
 - b. Only combine warranties of related Divisional Work together. Create new letters for additional Divisions as necessary.
 - 4. Indicate the effective Warranty Date. As noted in Section 1.3.F above, the Warranty Date shall be the date the Certificate of Substantial Completion was signed by the City Engineer.
 - 5. Contractor Letters of Warranty shall only be signed by a principal officer of the company.

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6. After signing the letter provide the GC with a high quality color scanned image in PDF format and the original signed letter.
 - B. The GC shall be responsible for the Final Warranty submittal as identified in Section 3.04 below.
 - C. The GC shall obtain letters of warranty from all of the following:
 1. The General Contractor shall provide warranty letters for all Work that was self performed under the contract documents, identify all trades or Divisions of Work.
 2. All Sub-contractors shall provide warranty letters for Work performed under the contract documents; identify all trades or Divisions of Work.
 3. Suppliers, as required by other specifications within the Construction Documents where the manufacture of a specific product unique to the Work of this contract was required.
 - a. The terms and conditions of the Supplier Letter of Warranty shall be as defined by the specifications associated with the Work but shall not be less than the industry standard of repair, or replace defective materials and workmanship within one (1) year of the warranty date.
 - b. When the supplier is also the installer a single written letter may be submitted identifying both the warranty for the manufacture of the product and the warranty for the installation of the product.
 4. Installers as required by other specifications within the Construction Documents where the installation of a specific product unique to the Work of this contract was required.
 - a. The terms and conditions of the Installer Letter of Warranty shall be as defined by the specifications associated with the Work but shall not be less than the industry standard of repair, or replace defective materials and workmanship associated with the installation of the product within one (1) year of the warranty date.
 5. Special Letters of Warranty shall be required from any contractor, supplier, installer or manufacturer who agrees to provide warranty services required by any Division Specification in excess of their Standard Product Warranty.

3.03 STANDARD PRODUCT WARRANTY

- A. All contractors shall be responsible for collecting and providing copies of all standard product warranties for commercially available products purchased and installed under this contract.
 - B. Only one copy of the manufacturers' standard warranty needs to be submitted as representative for all quantities of the same model number used throughout the Work.
 - C. Provide the manufacturers certificate, letter, or other standard documentation for each Standard Product Warranty submitted as follows:
 1. Whenever possible a PDF version of the document shall be used.
 - a. If a PDF version is used all additional information shall be completed using simple PDF editing tools such as text boxes, highlight, etc.
 - b. If a PDF version is not available and an original document is furnished the additional information shall be neatly hand written and highlighted on the document in such a fashion so that it does not obscure any part of the written warranty.
 2. Provide the following additional information on each warranty document:
 - a. Contract warranty date.
 - b. Provide the manufacturer name and model number of the product if not specified within the warranty.
 - 1) Where the manufacturer name and model number is specified within the warranty it shall be highlighted for visibility.
 - c. Provide the plan identifier (LAV-1, WC-2, etc) when applicable.
 - D. Each completed warranty shall be saved as a digital PDF. The file shall be named using the specification number and item description. (i.e. 22 42 00 Toilet (WC-1).pdf)
-

- a. Where an original certificate was furnished provide a high quality colored scan of the completed document with the additional information. Save the scanned image in PDF format and use the same naming convention as indicated above.
- E. Provide all PDF files and any original documents to the GC for final consolidation to be provided to the Owner.

3.04 FINAL WARRANTY SUBMITTAL

- A. The GC shall receive all required warranties (digital PDF and any original documents) from all contractors, suppliers, installers and manufacturers.
- B. The GC shall inventory all received warranties with the Warranty Submittal List to ensure all required warranties have been received and all warranty periods are correct according to the specifications.
- C. Provide with each Operation and Maintenance Manual a complete copy of any associated warranty.
- D. Scan all warranties into a single organized electronic PDF file as follows:
 - 1. Organize the PDF file into an orderly sequence based on the table of contents of the Specifications.
 - 2. Provide a typed Table of Contents for the entire file at the front of the document.
 - 3. Provide bookmarks and links to each individual PDF to enable quick navigation through the PDF document.
- E. Upload the warranty submittal to the appropriate document library on the Project Management Web Site for review by the Project Architect (PA)/Project Engineer (PE) and CPM.
- F. Correct any deficiencies or omissions and resubmit as necessary.

3.05 WARRANTY NOTIFICATION, RESPONSE, EXECUTION AND FOLLOW-UP

- A. Warranty Notification:
 - 1. The City of Madison, Project Management Web Site, uses an email notification system for all warranty related issues. The GC will be required to provide, and keep current during the warranty period, a minimum of two (2) email addresses and phone numbers of current employees to receive email notifications and provide response regarding Work associated with these construction documents.
 - a. In the event a Warranty Issue is deemed by the City of Madison to be an emergency, the GC shall first receive a phone call with a follow-up email from the Project Management Web Site.
 - b. The Contract Closeout-Warranty Issue Library on the Project Management Web Site uses a form for each warranty issue that is logged into the system.
 - 1) The GC shall open each warranty issue form, review the issue description and any attached documentation or photos.
 - 2) The GC shall also notify any other sub-contractor, supplier, or installer that may be required to review the warranty issue.
- B. Warranty Response:
 - 1. The GC shall upon notification by the City of Madison provide warranty response as follows:
 - a. Critical Systems or equipment: Where damage to equipment and other building components, or injury to personnel is probable provide immediate emergency shut-down information and an on-site response team as soon as possible but in no case shall on-site response exceed 24 hours.
 - b. For non-critical responses where damage or injury is unlikely provide on-site response no later than the next business day.
 - c. Where Technical Assistance support is part of the written warranty provide all assistance necessary via phone, text, or internet systems as indicated by the warranty. If issues cannot be resolved provide on-site response no later than the next business day.

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- d. If the request cannot be supported in sufficient time as outlined above the Owner (or Owner Representative) reserves the right to contact other contractors or service companies having similar capability to expedite the repair or replacement and shall invoice all associated costs to the Owner back to the GC.
- C. Warranty Execution:
- 1. The GC shall provide all repairs or replacements as necessary to restore broken or damaged Work to the original level of acceptance as intended by the Contract Documents.
 - a. Provide all materials, equipment, products, and labor necessary to complete the repair or replacement associated with the Warranty Issue.
 - b. Provide all cleaning services as may be required before, during, and after the repair or replacement as per Specification 01 74 13 Progress Cleaning.
 - c. Provide any protection necessary for existing construction as per Specification Section 01 76 00 - Protecting Installed Construction.
 - d. Provide new letters of warranty when required.
- D. Warranty Follow-up:
- 1. Logged Warranty Issues:
 - a. The GC shall provide complete documented responses of all logged Warranty Issues. Responses shall provide a description of work completed, by who, inclusive dates, and photos of completed or repaired work.
 - 1) Provide call back response if work is not acceptable.
 - b. The City Project Manager shall review the submitted response documentation and do a field inspection if necessary.
 - 1) If work is not acceptable, contact GC to review details and expectations of the repair as needed.
 - 2) If work is acceptable close the Warranty Issue.
 - 2. Quarterly Warranty Reviews:
 - a. The GC shall be responsible for scheduling quarterly on-site review with all of the following:
 - 1) City Project Manager, and other City staff as needed.
 - 2) Owner and Owner Tenant Representative.
 - 3) Commissioning Agent (CxA).
 - 4) Plumbing, Heating, Electrical Sub-contractors.
 - 5) Other Sub-contractors that may be responsible for open Warranty issues.
 - b. Quarterly reviews shall be scheduled at 3 months, 6 months, and 11 months after the effective date of the warranty. The review meetings shall:
 - 1) Review the status of all open Warranty Issues, determine course of action and estimated date of completion.
 - 2) In the appropriate quarter, provide shut-down, start-up, testing, and training of off-season equipment as required by the contract documents.
 - 3) The 11th month review shall review all open Warranty Issues, final plan for resolution, and all Warranty Issues where a new letter of warranty may have been issued.

END OF SECTION

**SECTION 01 78 39
AS-BUILT DRAWINGS**

PART 1 – GENERAL

1.01 SUMMARY

- A. This specification is intended to provide clear guidelines and identify the responsibilities of all contractors as they pertain to City of Madison contract procedures regarding the accurate recording of the Work associated with the execution of this contract. This shall include but not be limited to work that will be hidden, concealed, or buried.
- B. Each contractor shall be responsible for maintaining an accurate record of all installations, locations, and changes to the contract documents during the execution of this contract as it may relate to their specific division or trade.
- C. The General Contractor (GC) shall be responsible for ensuring all contractors provide as-built record information to the Master As-Built Document Set as described in this specification.

1.02 RELATED SPECIFICATIONS

- A. 00 31 21 - Survey Information.
- B. 01 26 13 - Request for Information.
- C. 01 31 23 - Construction Bulletin.
- D. 01 32 33 - Photographic Documentation.
- E. 01 26 63 - Change Orders.
- F. 01 29 76 - Progress Payment Procedures.
- G. 01 31 23 - Project Management Web Site.
- H. 01 33 23 - Submittals.
- I. 01 77 00 - Closeout Procedures.
- J. 01 91 00 - Commissioning.
- K. Other Divisions and Specifications that may address more specifically the requirements for field recording the installation of all items associated with the execution of this contract by Division or Trade.

1.03 RELATED DOCUMENTS

- A. Other related documents shall include but not be limited to the following:
 - 1. Bidding documents including drawings, specifications, and addenda.
 - 2. Required regulatory documents of conditional approval.
 - 3. Field orders, verbal or written by inspectors having regulatory jurisdiction.
 - 4. Shop drawings and installation drawings.

1.04 PERFORMANCE REQUIREMENTS

- A. The GC shall be responsible for maintaining the "Master As-Built Document Set" in the job trailer at all times during the execution of this contract. This document set shall include all of the following:
 - 1. Master As-Built Plan Set.
 - 2. Master As-Built Specification Set.
 - 3. Other Document Sets.
 - B. The GC shall designate one person of the GC staff to be responsible for maintaining the Master As-Built Document Set at the job trailer. This shall include, posting updates, revisions, deletions and the monitoring of all contractors posting as-built information as described in this specification.
 - C. All contractors shall use this specification as a general guideline regarding the requirements for documenting their completed Work. Contractors shall explicitly follow additional specification requirements within their own Division of Trade as it may apply to this specification.
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1.05 QUALITY ASSURANCE

- A. The GC shall be responsible for all of the following:
 - 1. Spot checking all sub-contractors field documents to insure daily information is being recorded as work progresses.
 - 2. Discuss as-built recording to the plan set at weekly job meetings with all sub-contractors on site.
 - 3. Schedule time with sub-contractors in the job trailer for recording as-built information to the plan set.
 - 4. Insure that all sub-contractors are providing clear and accurate information to the plan set in a neat and organized manner.
 - 5. Insure sub-contractors who have completed work have finalized recording all as-built information to the plan set before releasing them from the project site.
- B. The Project Architect, the City Project Manager, Commissioning Agent and other design team staff will perform random checks of the Master As-Built Document Set during the execution of this contract to ensure as-built information is being recorded in a timely fashion as the Work progresses. An updated and current Master As-Built Document Set is a stipulation for approval of the progress payment.

PART 2 – PRODUCTS

2.01 OFFICE SUPPLIES

- A. The GC shall provide a sufficient supply of office products in the job trailer at all times for all contractors to use in recording as-built information into the plan set. This shall include but not be limited to the following:
 - 1. Red ink pens, medium point. Pens that bleed through paper, markers, and felt tips will not be accepted.
 - 2. The use of highlighters is acceptable. Assign colors to various trades for consistency in recording information.
 - 3. Straight edges of various lengths for drawing dimension, extension and other lines.
 - 4. Civil and Architectural scales
 - 5. Clear transparent, non-yellowing, single sided tape.
 - 6. Correction tape or correction fluid for correcting small errors.

PART 3 - EXECUTION

3.01 FIELD DOCUMENT AS-BUILTS

- A. The GC and all Sub-contractors shall be responsible for keeping their own field set of as-built documents including plans, specifications and published changes.
- B. Field sets shall be kept dry and in good condition at all times.
- C. No Work shall be buried, covered, or hidden, by any additional Work, regardless of Contractor or Trade, until locations of all materials and equipment has been properly documented as described below.
- D. All contractors shall be required to record the following as-built information:
 - 1. Notes on the daily installation of materials and equipment.
 - 2. Sketches, corrections, and markups indicating final location, positioning, and arrangement of materials and equipment such as pipes, conduits, valves, cleanouts, pull boxes and other such items. Note all final locations on plan sheets, indicate dimension off identifiable building features. Riser diagrams need only be corrected for significant changes in locations, routing or configuration.
 - a. The use of photographs in lieu of hand drawn sketches is acceptable.
 - b. Photos shall be taken according to Specification 01 32 33 Photographic Documentation
 - c. Print photo and markup with dimensions or notes as necessary.
 - 3. Identify by the use of existing plan symbology and notes the size, type, quantity, and use as applicable of materials such as pipes, valves, conduits, etc.

4. Note whether horizontal runs are below slab or above ceiling, include dimensions above or below finished floor elevation.
- E. All contractors shall be responsible for transferring the information from their field set of documents to the Master As-Built Plan Set kept in the GC job trailer. See Section 3.3.D. below for the proper procedure.
- F. All contractors shall update the GC Master Plan Set as often as necessary, but not less than once per work week.

3.02 SITE SURVEY AS-BUILT

- A. The Land Surveyor Sub-Contractor shall provide digital as-built information including but not be limited to the following:
 1. For underground buried utility laterals and services of all types locate all of the following that may apply:
 - a. Connection points at all mains.
 - b. Storm discharge points to open air.
 - c. All corners and bends regardless of angle, large radius sweeps shall have multiple point locations sufficient to define the sweep.
 - d. All vertical drops.
 - e. All wells.
 - f. Private buried utilities such as buried electrical cables, irrigation systems, etc.
 - g. Other information that may need to be located in the future by the owner prior to digging.
 2. Record all surface features including but not limited to the following:
 - a. Building corners, pavement edges, and other permanent structural features.
 - b. All surface covers for inlets, catch basins, cleanouts, access structures, curb stops and other such devices.
 - c. Other permanent surface features such as hydrants, lamp posts, and other permanent site amenities.
 3. The following data shall be recorded while locating items in sub-sections 3.2.a and 3.2.b above:
 - a. Flow lines at both ends of pipes.
 - b. Pipe sizes and material types.
 - c. Rim elevations for all covers.
 - d. Sump elevations and invert elevations of all structures.
 - e. Spot elevations for all pads, driveways, walks, stoops, and floors.
- B. The Surveyor shall provide the final digital as-built on a media and in a format specified in Specification 00 31 21 Survey Information to the GC for turn in to the Project Architect and the Civil Engineer.
- C. The Surveyor shall provide two printed as-built site plans to the GC for inclusion in the Master As-Built Plan Set as follows:
 1. One sheet to show all features (but not contour information) with text neatly organized for each item identified.
 2. One sheet showing contours, contour labels, and features from item 1 above, but with no additional text.

3.03 MASTER AS-BUILT DOCUMENT SET

- A. The GC shall be responsible for maintaining the Master As-Built Document Set in the job trailer at all times.
 1. The Master As-Built Plan Set (Plan Set) shall begin with one complete bid set of drawings and any additional sheets that were supplied by published addenda during the bidding process. The cover sheet shall be titled as the "Master As-Built Plan Set" in large bold red letters approximately 2" in height and shall not be used for any other purpose.
 2. The Plan Set shall be kept dry, legible, and in good condition at all times.

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3. The Plan Set shall be kept up to date with new revisions within two (2) working days of supplemental drawings being issued. Revisions shall be posted as follows:
 - a. Insert new, revised sheets into the plan set. Void old sheets but do not remove them from the plan set. Indicate date received and what document (RFI, CB, CO, etc) caused the change.
 - b. Insert new, revised individual details into the plan set. Void old details, tape new details over the old details with a "tape hinge" to allow them to be viewed. Indicate date received and what document (RFI, CB, CO, etc) caused the change.
 - c. Add new details in appropriate white space on relevant sheets. If no space is available use the back side of the previous sheet or insert a new sheet. Indicate date received and what document (RFI, CB, CO, etc) caused the change.
 4. The Plan Set shall be available at anytime for easy reference during progress meetings and for emergency location information of new work already completed.
 5. The Master As-Built Specification Set (Spec Set) shall begin with one complete bid set of specifications and any additional specifications that were supplied by published addenda during the bidding process. The Spec Set shall be provided in three "D" ring type binders of sufficient thickness to accommodate the specification set. Multiple binders are allowed as necessary. Label the front cover and binding edge with "Master As-Built Specifications" in bold red letters. Provide other information as necessary to distinguish the contents of multi-volume sets.
 6. The Spec Set shall be kept dry, legible, and in good condition at all times.
 7. The Spec Set shall be kept up to date with new revisions within two (2) working days of supplemental drawings being issued.
 8. The Spec Set shall be available at anytime for easy reference during progress meetings.
 9. Other Document Sets may be kept at the GCs option in three "D" ring type binders of sufficient thickness to accommodate the documentation. Other documentation sets may include but not be limited to RFIs, CBs, COs, etc.
- B. The Land Surveyor Sub-Contractor shall be required to use digital surveying for all exterior site surveying, and provide deliverable digital as-builts as specified in Specification 00 31 21 Survey Information. As soon as practical the surveyor shall provide the GC with a preliminary copy of installed buried utilities for inclusion with the plan set in the job trailer. The surveyor shall provide final digital as builts as per section 3.2 above.
- C. All contractors shall be responsible for updating the Plan Set from their field sets at least once per work week. Updates shall include but not be limited to the following procedures:
1. All updates shall be done only in red ink. Place a "cloud" around small areas of correction to call attention to the change.
 2. Whenever possible place general work notes, field sketches, supplemental details, photos, and other such information on the reverse side of the preceding sheet. Installation notes including dates shall be kept neatly organized in chronological order as necessary.
 3. Accurately locate items on the plan set as follows:
 - a. For items that are located as dimensioned provide a check mark or circle indicating the dimension was verified.
 - b. For items that are within 5 feet (152.4 cm) of the location indicated on the plans leave as shown and:
 - 1) Provide correct dimensions to existing dimension strings or,
 - 2) Accurately locate with new dimension strings
 - c. For items that are more than 5 feet (152.4 cm) from the location indicated on the plans
 - 1) Accurately draw the items in the new location as installed and,
 - 2) Accurately locate with new dimension strings and,
 - 3) Note that the existing location is void.
 4. Include dimensioned locations for items that will be buried, concealed, or hidden in the ground, under floors, in walls or above ceilings.
-

- a. Dimensions shall be pulled from identifiable building features, not from centers of columns or other buried features.
- b. When necessary pull more dimensions as needed from opposing directions to properly locate single items.

3.04 AS-BUILT REVIEW AND ACCEPTANCE

- A. The GC shall provide the Master As-Built Plan Set to the Project Architect (PA)/Project Engineer (PE), the City Project Manager (CPM), the Commissioning Agent (CxA) and other design team staff for content review prior to the Progress Payment Milestone indicated in Specification Section 01 29 76 - Progress Payment Procedures. The submitted plan set shall include the digital survey information produced under Section 3.2 above.
 1. If the plan set is not approved:
 2. The PA/PE and CPM shall only be required to generalize deficiencies by trade there shall be no requirement or expectation to generate a "punch list" of required corrections.
 3. The GC and Sub-contractors as necessary shall be responsible for inspecting the installation and correcting the drawings as needed.
 4. The GC shall re-submit the plan set for review.
 5. If the plan set is approved the PA/PE shall take possession of the plan set to be used in providing the owner with digital CAD record drawings. Upon completion of transferring the information to CAD the PA/PE shall provide the Owner with CAD record drawings, record PDFs, and the Master As-Built Plan Set.

3.05 CHANGES AFTER ACCEPTANCE

- A. No Contractor shall be responsible for making changes to the As-Built record documents after acceptance by the PA/PE and CPM except when necessitated by changes resulting from any Work made by the Contractor as part of their guarantee.

END OF SECTION

SECTION 01 78 43
SPARE PARTS AND EXTRA MATERIALS

PART 1 – GENERAL

1.01 SUMMARY

- A. This specification is intended to provide clear guidelines and identify the responsibilities of all contractors as they pertain to City of Madison contract procedures regarding spare parts, special tools, special materials, and extra materials.
- B. Each contractor shall be responsible for knowing the specific requirements of their Division Specifications as they may relate to the general information provided in this specification.
- C. The General Contractor (GC) shall be responsible for ensuring all contractors provide spare parts and extra materials as described in this specification.

1.02 RELATED SPECIFICATIONS

- A. 01 29 76 - Progress Payment Procedures.
- B. 01 31 23 - Project Management Web Site.
- C. 01 77 00 - Closeout Procedures.
- D. Other Divisions and Specifications that may address more specifically how to proceed with spare parts, special tools, special materials, and extra materials.

1.03 DEFINITIONS

- A. Spare Parts: Any component of a product or assembly that comes pre-packaged or was specially ordered for the explicit use of the product or assembly. This shall include but not be limited to fastening devices, mounting brackets, replacement parts, wheels, pulleys, wiring, alternate assembly pieces, etc.
- B. Special Tools: Any tool of any kind that was pre-packaged or specially ordered, and is required to be used for the installation or maintenance of an installed product or assembly as part of this contract.
- C. Special Materials: Any oil, lubricant, glue, touch-up paint, or other such material that comes pre-packaged or was specially ordered and is required to be used for the installation or maintenance of an installed product or assembly as part of this contract.
- D. Extra Materials (Attic Stock): Any surplus materials in new and useable condition that was installed a part of this contract. Attic Stock shall include but not be limited to the following: ceiling tiles, paint, stain, floor coverings, ceramic tiles, light bulbs/lamps, filters, strainers, etc. Attic Stock shall include partially opened bulk items and additional unopened quantities as directed by other specifications.

1.04 PERFORMANCE REQUIREMENTS

- A. All contractors shall be responsible for consolidating spare parts, special tools, special materials, and attic stock as it pertains to the specific Work within their Division or Trade.
- B. All contractors shall use this specification as a general guideline regarding the requirements for turning spare parts, special tools, special materials, and attic stock over to the owner. Contractors shall explicitly follow specification requirements within their own Division of Trade.

1.05 QUALITY ASSURANCE

- A. The General Contractor (GC) shall be responsible for all of the following:
 - 1. Coordinate the location for and the delivery of all spare parts, special tools, special materials, and attic stock being provided by all contractors under this contract to one centralized location as designated by the Owner.
 - 2. Verify that all items being delivered are:
 - a. Clean, new, and in a usable condition.
 - b. Properly sealed, protected, and labeled.
 - c. Properly documented.

PART 2 – PRODUCTS – THIS SECTION NOT USED**PART 3 - EXECUTION****3.01 PACKAGING**

- A. Whenever possible all surplus items should remain in their original packaging such as parts envelopes.
- B. Package small parts in re-sealable plastic bags (Ziploc) or envelopes with clasp fasteners. Do not use envelopes that seal with glue or tape envelopes closed. Do not leave packaging unsealed.
- C. Package like parts together for products or assemblies. (i.e., keep all spare parts for flushometers together).
- D. Many small packages may be grouped together into a larger container by trade.
- E. Do not use unrelated boxes or containers for packaging spare items. (i.e. do not use a light fixture box for spare breakers, or flushometers parts).

3.02 LABELING

- A. Whenever possible the original labeling indicating part numbers and other pertinent information shall remain on the original packaging.
- B. If original labeling is not available the contractor shall label all parts and packages using tape or labels and permanent black markers. Tape or labels being used shall absorb the permanent marker without bleeding or allowing ink to be smeared or rubbed off.
- C. Labels shall include the name of the product or equipment the item belongs to, part number and/or name, and any other information that would assist maintenance personnel in identifying the piece and related product.
- D. Labels shall include plan or specification designations (WC-1, LAV-3, DF-2, CPT-1, etc) that identify the particular product or finish material it represents.
- E. Labels for parts stored in clear re-sealable plastic bags may be placed inside the bag. Label shall face out and be able to be read from one side. Multiple bags shall be numbered individually for identification.
- F. Label the outside of large containers with the trade name (Plumbing, Electrical, etc).

3.03 INVENTORY

- A. All contractors shall provide the GC with complete inventories of all spare parts, special tools, special materials, and attic stock that they are providing at the end of the contract. The inventories shall be organized as follows:
 - 1. The cover sheet shall indicate the Contractors name, address, phone number, identify that the document is the "Spare Parts and Extra Materials Inventory", and identify the Division or Trade the inventory is for.
 - 2. Provide an inventory in a tabular format of all items being provided under this and other specifications. The minimum information to be provided for each item on the inventory shall be as follows:
 - a. Bag or container number, all items of one bag or container shall be grouped together on the inventory.
 - b. Item description.
 - c. Item size (if applicable).
 - d. Total quantity provided.
 - e. Identify if item is a spare part, tool, special material, or attic stock.
- B. The GC shall consolidate inventories from all sub-contractors into one tabular data sheet organized by Division or Trade of Work.
 - 1. Upon completing the consolidated list the GC shall upload the completed inventory to the Contract Closeout-Attic Stock Library on the Project Management Web Site.

2. The GC shall notify the Project Architect and City Project Manager that the scans have been uploaded.
3. Consulting Staff and Owner Staff shall review the inventories prior to Final Review to verify that minimum required quantities have been met. Deficiencies shall be noted and returned back to the GC for corrective action.

3.04 STORAGE

- A. Prior to the 80% Progress Payment milestone the GC shall coordinate with the City Project Manager and Maintenance Personnel where spare parts, special tools, special materials, and attic stock shall be stored.
- B. The GC shall instruct all contractors as to the location and proper storage procedures.
- C. The GC shall be responsible for ensuring the storage area is kept neat and orderly as follows:
 1. Like items are stored together by material, product, or trade as necessary.
 2. Liquids are stored in sealable containers and the lids have been properly installed to prevent drying out, spillage, etc.
 3. All labels are clearly visible and provide the required information.
- D. Large items shall be stored so as not to damage other items. Do not stack heavy items or items with distinct shapes/outlines on softer items that may get crushed or imprinted.

3.05 CLOSEOUT PROCEDURE

- A. Prior to the 90% Progress Payment milestone the GC shall review all attic stock already stored by the contractors to ensure the following:
 1. Materials are stored in the proper location(s).
 2. All boxes, containers and items are properly labeled according to the submitted/approved inventory.
 3. Quantities are correct according to the submitted/approved inventory.
- B. The GC shall ensure that all deficiencies are corrected prior to conducting Demonstration and Training Sessions.
- C. The GC shall review with Maintenance Staff all inventories and labeling during the scheduled Demonstration and Training Sessions.
- D. Any discrepancies associated with Attic Stock shall be resolved and verified prior to the CPM releasing the 90% CT progress payment.

END OF SECTION

**SECTION 01 79 00
DEMONSTRATION AND TRAINING**

PART 1 – GENERAL

1.01 SUMMARY

- A. The purpose of this specification is to provide clear responsibilities and guidelines related to providing Demonstration and Training (D&T) Sessions related to general facility use, equipment, systems, finishes, and materials to City of Madison Staff (Owner, Owner Representatives, Maintenance, and Custodial Personnel) as needed.
- B. All D&T shall be coordinated through the General Contractor (GC), Project Architect /Project Engineer (A/E PROJ MGR) and City Project Manager (CPM), and will be based on or customized to the needs of City of Madison Staff being trained. New equipment and systems may have complete D&T sessions as described in this specification while equipment or systems staff is familiar with may have sessions more focused on maintenance only.

1.02 RELATED SPECIFICATIONS

- A. Section 01 29 76 - Progress Payment Procedures.
- B. Section 01 78 13 - Completion and Correction List.
- C. Section 01 78 19 - Maintenance Contracts.
- D. Section 01 78 23 - Operation and Maintenance Data.
- E. Section 01 78 36 - Warranties.
- F. Section 01 78 39 - As-Built Drawings.
- G. Section 01 78 43 - Spare Parts and Extra Materials.
- H. Section 01 91 00 - Commissioning.
- I. Other Divisions and Specifications that may address more specifically the requirements for D&T sessions related to the installation of all items and equipment installed under the execution of the Work.

1.03 QUALITY ASSURANCE

- A. All contractors shall have the responsibility of preparing for and conducting D&T sessions as determined by this and other Division or Trade related specifications, Owner Operation and Maintenance Manuals, and other such documentation related to the Work.
- B. The GC shall have responsibility for:
 - 1. Ensuring that all contractors required to conduct a D&T session have successfully completed all of the following:
 - a. Turned in all required documentation for review and documentation has been approved/accepted prior to scheduling D&T sessions.
 - b. Other required documentation as needed is available and ready for use during the D&T session.
 - c. All systems have been started, tested, and running as per appropriate specification and/or manufacturers recommendations prior to scheduling D&T sessions.
 - d. All contractors are sufficiently prepared for their D&T session
 - e. Documents the D&T session including date, time, contractor and company name, attendees and other information regarding the session
 - 2. Organizing the coordination and scheduling of all D&T sessions between all contractors and the appropriate representatives of the Owner. These representatives may include any of the following depending on the Work of the Contract:
 - a. Owner – end users.
 - b. Facility Maintenance personnel:
 - 1) Facility general operation procedures including custodial services.

- 2) Electrical.
- 3) Mechanical.
- 4) Plumbing.
- 5) Site.
- c. Information Technology (IT) Department.
- d. Traffic Engineering – Radio Shop.
- e. Architects, Engineers and Facility Management staff as project completion overview.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

- A. The GC shall develop a specific D&T plan to be scheduled and conducted as described below but no sooner than the meeting discussed in 3.02.A.2 below.
- B. The GC shall not schedule D&T sessions to preclude required personnel from attending multiple sessions.

3.02 COORDINATING AND SCHEDULING THE TRAINING

- A. The GC, A/E PROJ MGR, CxA and CPM, shall review all Training and Demonstration requirements during two (2) special meetings.
 - 1. The first meeting shall be held at the 50% Contract Total Payment. During this meeting the following shall be discussed:
 - a. Preliminary schedule of training dates to be completed prior to beginning construction closeout.
 - b. List of documentation and items that need to be completed and available before and during the training session.
 - c. Who (Owner, Maintenance, etc) will be attending what training session(s).
 - 2. The second meeting shall be held at the 80% Contract Total Payment. This meeting shall review due outs that have not yet been completed for the 90% Contract Total Payment and the requirements necessary for Construction Closeout. All Demonstration and Training sessions shall be completed prior to receiving the 90% progress payment and beginning Construction Closeout Procedures (see Specification 01 77 00).
 - a. This does not include any requirement associated with off season equipment preparation and/or demonstration and Training Sessions.
- B. All of the Construction Work shall be operationally ready prior to conducting training as follows:
 - 1. All contractors shall have their As-Built Drawing Records available for reviewing locations of system components during training.
 - 2. All final and approved Operations and Maintenance Data shall be completed no less than two (2) full weeks prior to the scheduled training.
 - 3. All systems shall have been started, functionally tested, balanced, and fully operational, and all piping and equipment labeling complete at least two (2) days prior to the scheduled training.
 - a. Seasonal equipment shall not be trained out of season. Contractors having seasonal equipment shall work with the GC and CPM for coordinating additional training sessions as appropriate for seasonal equipment.
- C. Correction list items that prevent a piece of equipment or system from being fully operational for training shall be corrected prior to conducting the training.

3.03 TRAINING OBJECTIVES

- A. For each piece of equipment or system installed train on the following objectives/topics as applicable:
 - 1. System design, concept, and capabilities.
 - 2. Review of related contractor as-built drawings.
 - 3. Facility walkthrough to identify key components of the system.
 - 4. System operation and programming including weekly, monthly, annual test procedures.

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5. System maintenance requirements.
 6. System troubleshooting procedures.
 7. Testing, inspection, and reporting requirements associated with any regulatory requirements.
 8. Identification of any correction list items still outstanding.
 9. Review of system documentation including the following:
 - a. Operation and maintenance data.
 - b. Warranties.
 - c. Valve charts, tags, and pipe identification markers.
- B. For each piece of specialty equipment train on the following objectives/topics as applicable:
1. Manufacturers operations instructions.
 2. Manufacturers use and care instructions.
 3. Manufacturers maintenance and troubleshooting instructions.
 4. System operation and programming including weekly, monthly, annual test procedures.
 5. Identification of any correction list items still outstanding.
 6. Review of system documentation including the following:
 - a. Operation and maintenance data.
 - b. Warranties.
- C. End User Orientation
1. Facility walkthrough.
 2. Security and emergency features.
 3. General facility operation procedures.
- D. Facility General Use and Custodial Services – if requested.
1. Facility walkthrough.
 2. Security and emergency features.
 3. General facility operation procedures.
 4. Care and maintenance of specialty items, finishes, etc as requested.
 5. Attic stock inventory and material designations.

3.04 DEMONSTRATION AND TRAINING PROGRAM PREPARATION

- A. Each contractor having a responsibility for providing D&T sessions shall meet with the GC, CPM, and other City Staff as needed to review the extent of the Training Objectives in section 3.03 above needed for each piece of equipment, system, finish, etc. This meeting shall occur no less than four (4) weeks prior to the anticipated training session.
- B. The contractor shall use the information from item 3.04.A above to prepare a formal training program for each piece of equipment or system based on the Training Objectives in 3.03 above.
1. The formal training program shall include the following information:
 - a. Session title
 - b. List of systems, equipment, use, care, etc to be covered during the session
 - c. Provide the following for each systems, equipment, use, care, etc to be covered during the session
 - 1) Name and affiliation of each instructor to be used. As needed and discretion of the Owner the GC to require attendance by the installing technician, installing Contractor and the appropriate trade or manufacturer's representative.
 - 2) Qualifications of each instructor to be used. Practical building operation expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment as installed in this project is required by the training personnel. If Owner determines training was not adequate, the training shall be repeated until acceptable to Owner.
 - 3) A checklist of all documentation and system/equipment requirements necessary to complete a successful training session and the current status of each
 - 4) Any additional documents, training aids, video or other items to be used to complete the training

- 5) Any special requirements or needs associated with item iv above to complete the training
 - d. The intended audience for the training
 - e. The approximate duration of each objective or topic to be covered
 2. Submit the completed training program to the GC for review and approval by the PA/PE and CPM.
- C. The PA/PE and CPM shall work with staff as necessary to ensure all points of anticipated training needs have been met. The PA/PE and CPM will approve the program as submitted or recommend changes for re-submittal as necessary.

3.05 CONDUCTING A DEMONSTRATION AND TRAINING SESSION

- A. All contractors shall conduct their required D&T Sessions as follows:
1. Begin with a classroom session.
 - a. Provide a sign in sheet indicating all training to be conducted, instructors, etc.
 - b. Provide an overview of the training to be conducted including the approximate schedule.
 2. Conduct a general walk-through of the site.
 - a. Point out locations of various equipment, valves, charts, and other related items.
 - b. Use the Division or Trade As-Built record drawings to indicate locations of hidden or buried items.
 3. Provide a demonstration of general equipment/system operation including using the O&M manual.
 - a. Startup and shutdown procedures.
 - b. Normal operational levels as depicted by any gauges, software, etc.
 - c. Indicate warning devices, signs etc. and demonstrate emergency shut-down procedures.
 4. Provide a demonstration of all owner level maintenance using the O&M manual.
 - a. Indicate frequency of maintenance.
 - b. Provide and review all spare parts, special tools, and special materials.
 5. Provide and review all spare parts, special tools, special materials, or attic stock as applicable.
 6. While conducting D&T sessions:
 - a. Allow hands on training whenever practical.
 - b. Answer questions promptly.
 - c. Repeat demonstrations and procedures as necessary.
- B. Within two (2) working days of completing the D&T session the contractor responsible for the session shall turn-in any documentation generated including the sign in roster to the GC.
- C. The GC shall turn over all training documentation to the PA/PE and CPM upon completion of D&T sessions.
- D. Re-schedule any training that has been determined to be inadequate or inappropriate for any reason including but not limited to any of the following;
1. Unqualified instructor.
 2. System installation incomplete or untested to the specifications.
 3. Equipment failure during demonstration.
 4. Un-expected cancellation.

3.06 CLOSEOUT PROCEDURE

- A. Prior to receiving the 90% Progress payment the GC shall:
1. Verify with the PA/PE and CPM that each Demonstration and Training Session was conducted properly and according to the submitted plan.
 2. Any required "Off Season" equipment testing, balancing, and Demonstration and Training Sessions have been tentatively scheduled with the GC, necessary sub-contractors, instructors and Owner/Owner Representatives as necessary.

END OF SECTION

SECTION 01 81 13
SUSTAINABLE DESIGN REQUIREMENTS – LEED FOR NEW CONSTRUCTION V4.0

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Comply with Wisconsin Commercial Building Codes/International Building Code (IBC).
- C. Comply with Americans with Disabilities Architectural Guidelines, and ICC/ANSI A117.1-Latest Edition.
- D. Comply with USGBC LEED prerequisites and credits needed for Project to obtain “LEED Silver (minimum) certification based on USGBC’s LEED v4.0 BD&C: New Construction and Major Renovations” Process.

1.02 SUMMARY

- A. Section includes general requirements and procedures for compliance with certain USGBC LEED prerequisites and credits needed for Project to obtain “LEED Silver (minimum) certification based on USGBC’s LEED BD&C: New Construction and Major Renovations” Version 4.0.
 - 1. Other LEED prerequisites and credits needed to obtain LEED certification depend on product selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests.
 - 2. Additional LEED prerequisites and credits needed to obtain the indicated LEED certification depend on Architect’s design and other aspects of Project that are not part of the Work of the Contract.
 - 3. A copy of the LEED Project checklist is attached at the end of this Section for information only.
 - 4. Specific requirements for LEED are included in greater detail in other Sections.
- B. A significant portion of the credits required for certification are the responsibility of the A/E and Owner (design credits). These credits are not explicitly outlined in this specification section, however many aspects of the construction documents reflect intent to document and achieve the design credits. This section documents requirements of the contractor to meet the requirements for documenting the construction credits.
- C. Related Sections: Divisions 01 through 32 Sections for LEED requirements specific to the work of each of these Sections. Requirements may or may not include reference to LEED.

1.03 DEFINITIONS

- A. Albedo (a.k.a. solar reflectance): The ratio of the reflected electromagnetic energy to the incoming electromagnetic energy.
- B. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
- C. Emissivity (a.k.a. infrared emittance): A parameter between 0 and 1 that indicates the ability of a material to shed infrared radiation.
- D. Environmental Product Declarations: (EPD) is a transparent, objective report that communicates what a product is made of and how it impacts the environment across its entire life cycle.
- E. Hydrofluorocarbons (HFCs): Refrigerants used in building equipment that do not deplete the stratospheric ozone layer.

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- F. LEED: Leadership in Energy and Environmental Design. Green Building Rating System representing the US Green Building Council's effort to provide a national standard for what constitutes a "green building". The standard requires quantitative and technical documentation to demonstrate compliance with goals described in the US Green Building Council's Green Building Rating System, Version 3.0.
 - G. LEED Project Administrator: LEED Certified Professional hired by the project owner to review LEED submittals.
 - H. Locally-Manufactured (for LEED™ Materials Credit 5): Refers to the final assembly of components into the building product that is furnished and installed by the trades people. For example, if the hardware comes from Seoul, South Korea, the lumber from Vancouver, British Columbia, and the joist is assembled in Kent Washington, then the location of the final assembly is Kent, Washington.
 - I. Post-Consumer Recycled Content: The percentage of waste material by weight available from consumer use incorporated into a building material.
 - J. Pre-consumer (aka Post-Industrial Recycled) Content: The percentage of waste material by weight available from industrial use incorporated into a building material. Post-industrial recyclable materials are different from industrial scrap, a by-product of industrial processes that can easily be reused as a feedstock.
 - K. Potable Water: Water that is suitable for drinking and is supplied from wells or municipal water systems.
 - L. Recycling: The collection, reprocessing, marketing and use of materials that were recovered or diverted from the solid waste stream. Note that LEED uses the term "pre-consumer" rather than "post-industrial." Also note that when manufacturers and trade associations use the term "post-industrial" it often includes spills, scraps, and damaged and surplus materials that are fed back into the same manufacturing process and that these materials are not considered recycled content by the LEED rating systems.
 - M. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.
 - N. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.
 - O. Regionally Manufactured Materials: Materials that are manufactured within a radius of 500 miles from Project site. Manufacturing refers to the final assembly of components into the building product that is installed at Project site.
 - P. Regionally Extracted and Manufactured Materials: Regionally manufactured materials made from raw materials that are extracted, harvested, or recovered within a radius of 500 miles from Project site.
 - Q. Solar Reflectance: See "Albedo."
 - R. Sustainable Forestry: The practice of managing forest resources to meet the long-term product needs of humans while maintaining the biodiversity of forested landscapes. The primary goal is to restore, enhance, and sustain a full range of forest values, both economic and ecological.
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- S. Type A Finishes: Material and finishes with potential for short-term levels of off gassing from chemicals inherent in their manufacturing process, or which are applied in form requiring vehicles or carriers for spreading which release high level of particulate matter in process of installation and/or curing. Including, but not limited to:
 - 1. Composite wood products, specifically including particleboard from which millwork, wood paneling, doors, or furniture may be fabricated.
 - 2. Adhesives, sealants, and glazing compounds, specifically those with petrochemical vehicles or carriers.
 - 3. Wood preservatives, finishes, and paint.
 - 4. Control and/or expansion joint-fillers.
 - 5. Hard finishes requiring adhesive installation.
 - 6. Gypsum board and associated finish processes.
- T. Type B Finishes: Fuzzy material and finishes which are woven, fibrous, or porous in nature and tend to adsorb chemicals off-gassed by Type A finishes or may be adversely affected by particulates. These materials become "sink" for deleterious substances which may be released much later, or collectors of contaminants that may promote subsequent bacterial growth. Including, but not limited to:
 - 1. Carpeting and padding.
 - 2. Fabric wallcovering.
 - 3. Insulation exposed to air stream.
 - 4. Acoustic ceiling materials.
 - 5. Fabric covered acoustic wall panels.
 - 6. Upholstered furnishings.
 - 7. Materials that can be categorized as both Type A and Type B.
- U. Ventilation: The process of supplying and removing air to and from interior spaces by natural or mechanical means.
- V. Volatile organic compounds (VOCs): Chemical compounds based on carbon and hydrogen structures that are vaporized at room temperatures. VOCs are one type of indoor air contaminant.
- W. Waste Materials: Large and small pieces of materials indicated which are excess to contract requirements and generally include materials salvaged from existing construction and items of trimmings, cuttings, and damaged goods resulting from new installations which cannot be effectively used in Work.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Respond to questions and requests from Architect and the Green Building Certification Institute (GBCI; an agent of USGBC that handles the review process) regarding LEED credits that are the responsibility of the Contractor, that depend on product selection or product qualities, or that depend on Contractor's procedures until GBCI has made its determination on the project's LEED certification application. Document responses as informational submittals.

1.05 ACTION SUBMITTALS

- A. General: Submit additional LEED submittals required by other Specification Sections.
- B. LEED submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated LEED requirements.
- C. LEED Submittals: Submit LEED related information under a separate Tab within each product submittal. The LEED submittal shall include:
 - 1. Summary Sheet: A summary, on General Contractors letterhead, of all LEED information requested in specifications shall include:
 - a. IMAGINATION CENTER AT REINDAHL PARK.

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- b. LEED Submittal List: A list of all materials being submitted. For products composed of multiple materials the submittal shall include a list of all materials composing the product.
 - c. For Products in Divisions 2 - 10, include the following information:
 - 1) Material costs, for each material on the LEED submittal list, excluding labor costs, delivery cost, cost of installation, as well as profit and overhead.
 - 2) The preconsumer and post-consumer recycled content of each material on the LEED submittal list.
 - 3) List of all material manufacturing locations.
 - 4) Provide distance between manufacturing and construction site.
 - d. All other LEED information required in specification.
2. Manufacturer's literature with information highlighted that confirm the figures used in the summary report.
- a. If a range is used in the manufacturer's literature, the summary report shall use the lowest number in the range.
 - b. For VOC Submissions: Submit MSDS sheets or manufacturer's literature with VOC figure highlighted.
- D. Project Material Costs Data: Provide a statement, on Contractor's letterhead, documenting the total material for the project. Include a spreadsheet tallying the material cost for all materials specified in Divisions 2 - 32. The total in the material cost data will be used in the LEED Online template to be completed by the Contractor as the actual material cost of the project.
- E. LEED Action Plan: Provide preliminary submittal within 30 days of Notice to Proceed that contains:
- 1. Example spreadsheets for each construction credit identified in this section.
 - 2. Contact information for Contractor's LEED coordinators.
 - 3. Brief description of how the following requirements will be met.
 - a. SS Prerequisite: Construction Activities Pollution Prevention complying with Section 31 25 00, Erosion Control.
 - b. MR Prerequisite: Construction and Demolition Waste Management Reporting
 - c. MR Credit: Construction and Demo Waste Management complying with Section 01 74 19 Construction Waste Management and Disposal. Include a sample spreadsheet showing how the tipping information is going to be recorded to comply with LEED requirements.
 - d. IEQ Credit: Low-Emitting Materials
 - e. IEQ Credit: Construction IAQ Management Plan
 - f. IEQ Credit: Indoor Air Quality Assessment
 - 4. After CPM approval of the Preliminary Action Plan the Contractor shall update the plan monthly with LEED information collected to date and be submitted as part of a monthly progress report.
- F. LEED Progress Reports: Concurrent with each Application for Payment, submit reports comparing the actual construction and purchasing activities with LEED requirements for the following:
- 1. SS Prerequisite: Construction Activities Pollution Prevention
 - 2. MR Prerequisite: Construction and Demolition Waste Management Reporting
 - 3. MR Credit: Construction and Demo Waste Management
 - 4. IEQ Credit: Low-Emitting Materials
- G. LEED Documentation Online Submittals: The Contractor shall be responsible for completing the following LEED submissions using the LEED online tool for credit submission to USGBC. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory for USGBC submission.
- 1. SS Prerequisite: Construction Activities Pollution Prevention
 - 2. MR Prerequisite: Construction and Demolition Waste Management Reporting
 - 3. MR Credit: Construction and Demo Waste Management
 - 4. IEQ Credit: Low-Emitting Materials
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1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For LEED coordinator.
- B. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:
 - 1. Furniture.
 - 2. Plumbing.
 - 3. Mechanical.
 - 4. Electrical.
 - 5. Specialty items such as elevators and equipment.
 - 6. Wood-based construction materials.

1.07 QUALITY ASSURANCE

- A. LEED Coordinator: The Contractor is to engage an experienced LEED-Accredited Professional to coordinate LEED requirements. LEED coordinator may also serve as waste management coordinator.

1.08 CONTRACTOR RESPONSIBILITIES

- A. This project has been registered with USGBC via LEED Online. The Contractor shall provide all necessary documentation for LEED BD&C v4.0 certification in accordance with the specifications. Format and content of all construction documentation must be in accordance with the LEED Reference Guide requirements for supporting data required in event of USGBC audit of the particular credit. Contractor is required to coordinate all requirements for credits stated in this section to assure assembled data is acceptable to USGBC and respond to USGBC requests for additional construction data in the course of preparing the project for certification.

PART 2 – PRODUCTS**2.01 LOW-EMITTING MATERIALS**

- A. Paints and Coatings
 - 1. For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
 - 1) Flat Paints and Coatings: 50 g/L.
 - 2) Non-flat Paints and Coatings: 50 g/L.
 - 3) Dry-Fog Coatings: 150 g/L.
 - 4) Primers, Sealers, and Undercoaters: 100 g/L.
 - 5) Rust-Preventive Coatings: 100 g/L.
 - 6) Zinc-Rich Industrial Maintenance Primers: 100 g/L.
 - 7) Pretreatment Wash Primers: 420 g/L.
 - 8) Clear Wood Finishes, Varnishes: 275 g/L.
 - 9) Clear Wood Finishes, Lacquers: 275 g/L.
 - 10) Floor Coatings: 50 g/L.
 - 11) Shellacs, Clear: 730 g/L.
 - 12) Shellacs, Pigmented: 550 g/L.
 - 13) Stains: 100 g/L.
 - 2. For field applications that are inside the weatherproofing system, 90 percent of paints and coatings shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Adhesives and Sealants

1. For field applications that are inside the weatherproofing system, adhesives and sealants shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
 - 1) Wood Glues: 30 g/L.
 - 2) Metal-to-Metal Adhesives: 30 g/L.
 - 3) Adhesives for Porous Materials (Except Wood): 50 g/L.
 - 4) Subfloor Adhesives: 50 g/L.
 - 5) Plastic Foam Adhesives: 50 g/L.
 - 6) Carpet Adhesives: 50 g/L.
 - 7) Carpet Pad Adhesives: 50 g/L.
 - 8) VCT and Asphalt Tile Adhesives: 50 g/L.
 - 9) Cove Base Adhesives: 50 g/L.
 - 10) Gypsum Board and Panel Adhesives: 50 g/L.
 - 11) Rubber Floor Adhesives: 60 g/L.
 - 12) Ceramic Tile Adhesives: 65 g/L.
 - 13) Multipurpose Construction Adhesives: 70 g/L.
 - 14) Fiberglass Adhesives: 80 g/L.
 - 15) Contact Adhesives: 80 g/L.
 - 16) Structural Glazing Adhesives: 100 g/L.
 - 17) Wood Flooring Adhesives: 100 g/L.
 - 18) Structural Wood Member Adhesives: 140 g/L.
 - 19) Single-Ply Roof Membrane Adhesives: 250 g/L.
 - 20) Special-Purpose Contact Adhesives (That Are Used to Bond Melamine-Covered Board, Metal, Unsupported Vinyl, Rubber, or Wood Veneer 1/16 Inch or Less in Thickness to Any Surface): 250 g/L.
 - 21) Top and Trim Adhesives: 250 g/L.
 - 22) Plastic Cement Welding Compounds: 250 g/L.
 - 23) ABS Welding Compounds: 325 g/L.
 - 24) CPVC Welding Compounds: 490 g/L.
 - 25) PVC Welding Compounds: 510 g/L.
 - 26) Adhesive Primer for Plastic: 550 g/L.
 - 27) Sheet-Applied Rubber Lining Adhesives: 850 g/L.
 - 28) Aerosol Adhesive, General-Purpose Mist Spray: 65 percent by weight.
 - 29) Aerosol Adhesive, General-Purpose Web Spray: 55 percent by weight.
 - 30) Special-Purpose Aerosol Adhesives (All Types): 70 percent by weight.
 - 31) Other Adhesives: 250 g/L.
 - 32) Architectural Sealants: 250 g/L.
 - 33) Non-membrane Roof Sealants: 300 g/L.
 - 34) Single-Ply Roof Membrane Sealants: 450 g/L.
 - 35) Other Sealants: 420 g/L.
 - 36) Sealant Primers for Nonporous Substrates: 250 g/L.
 - 37) Sealant Primers for Porous Substrates: 775 g/L.
 - 38) Modified Bituminous Sealant Primers: 500 g/L.
 - 39) Other Sealant Primers: 750 g/L.
2. For field applications that are inside the weatherproofing system, 90 percent of adhesives and sealants shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Flooring

1. Flooring shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. Composite Wood
 1. Composite wood, agrifiber products, and adhesives shall be made using ultra-low emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.
- E. Ceilings, Walls, and Thermal Insulation
 1. Ceilings, walls, and thermal insulation shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 – EXECUTION

3.01 NONSMOKING BUILDING

- A. Smoking is not permitted within the building or within 25 feet (8 m) of entrances, operable windows, or outdoor-air intakes.

3.02 CONSTRUCTION ACTIVITIES POLLUTION PREVENTION

- A. SS Prerequisite - Construction Activities Pollution Prevention:
 1. Follow LEED instructions in LEED NCv4.0 Reference Guide and complying with Section 31 25 00, Erosion Control. Comply with EPA Construction General Permit (CGP) standard 2012.
 2. Contractor is responsible for completing the LEED online credit template and attaching the following information to the template:
 - a. Provide record of compliance with Erosion and Sediment Control Plan:
 - 1) Monthly photographs of barriers and containment.
 - 2) Monthly photographs of dust control measures
 - 3) Records of inspections by agency in charge of overseeing compliance.
 - 4) Include dust control measures
 - b. Several early, a middle and several near end prevention plan checks and reports will be required as an upload to LEED Online – assume 6 checks and reports over the duration of the project.
 3. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory for GBCI submission.

3.03 BUILDING PRODUCT DISCLOSURE AND OPTIMIZATION

- A. MR Credits Building Product Disclosure Optimization – EPDs, Sourcing and Ingredients
 1. Environmental Product Declarations – comply with one or both of the following Options:
 - a. Option 1: Environmental Product Declarations (1 point)
 - b. Option 2: Multi-Attribute Optimization (1 point) including products that demonstrate impact reduction below industry average in global warming potential, ozone depletion, acidification of land and water, eutrophication, tropospheric ozone, or other USGBC approved program.
 2. Sourcing of Raw Materials – comply with one or both of the following Options:
 - a. Option 1: Raw Material Source and Extraction Reporting (1 point)
 - b. Option 2: Leadership Extraction Practices (1 point) including producer responsibility, bio-based materials, wood products, material reuse, recycle content or other approved USGBC program
 3. Material Ingredients - comply with one or two of the following Options:
 - a. Option 1: Material Ingredient Reporting (1 point)
 - b. Option 2: Material Ingredient Optimization (1 point) including GreenScreen v1.2 Benchmark, Cradle to Cradle Certification, REACH Optimization or other approved USGBC program.

- c. Option 3: Product Manufacturer Supply Chain Optimization (1 point) including products from manufacturers with validated and robust safety, health, hazard and risk programs that document 99% by weight of the ingredients used to make the product.
4. Contractor to complete and submit the MR building product disclosure and optimization calculator, available with the project in LEED Online
5. Contractor to submit supporting documentation including EPD and LCA reports, corporate sustainability reports, product declarations, labels, REACH, GreenScreen Benchmark, LT scores or other compliance summary documents. LEED project administrator and/or GBCI may require revisions and additions to this documentation and Contractor should plan accordingly.
6. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory for GBCI submission.

3.04 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT PLANNING

- A. MR Prerequisite and Credit: Comply with Division 1 Section "Construction Waste Management and Disposal".
 1. Contractor is required to create a Construction Waste Management Plan that includes:
 - a. Establishing waste diversion goals for the project by identifying at least five material streams targeted for diversion. Approximate a percentage of the overall project waste that these materials represent.
 - b. Specifying whether materials will be separated or commingled and describe the diversion strategies planned for the project. Describe where the material will be taken and how the recycling facility will process the material.
 - c. A final report detailing all major waste streams generated, including disposal and diversion rates.
 2. Contractor is required to meet the following minimum goal:
 - a. Option 1 Path 1 – Divert 50% and three material streams (1 point) , Option 1 Path 2 – Divert 75% and four material streams, or
 - 1) A material stream can be a specific material category that is diverted in a specific way or a mixture of several material categories that are diverted in a specific way.
 - 2) Best practice is that a material stream should constitute at least 5% (by weight or volume) of total diverted materials.
 - 3) Examples of material streams include Plastic, Carpet, Paper/Cardboard, Wood, metal, Sheetrock, Brick, Concrete, Shingles, deconstructed materials, commingled waste, reuse of deconstructed materials onsite, source separation where each material is sent to a specific facility or suppliers take-back of materials.
 - b. Option 2 – Do not generate more than 2.5 pounds of construction waste per square foot of the buildings floor area (2 points).
 3. Contractor is responsible for completing the LEED online credit template. Attached documentation in support of the credit shall include:
 - a. Monthly photographs of waste recycling sorting area including:
 - 1) Debris control fencing.
 - 2) Signage clearly identifying the containers content.
 - b. Spreadsheet containing the following information:
 - 1) Diverted materials description.
 - 2) Diverted materials/waste hauler name.
 - 3) Date of each haul.
 - 4) Quantity of material in each haul.
 - c. Copies of recycling vender and waste hauler tipping receipts.
 4. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory for GBCI submission.

3.05 ENHANCED INDOOR AIR QUALITY STRATEGIES

- A. IEQ Credit – Enhanced Indoor Air Quality Strategies: Intent is to promote occupants comfort, well-being and productivity by improving indoor air quality.
1. Install new air filtration media, with a MERV 13 Rating, in regularly occupied areas prior to occupancy.
 2. This is in addition to the set of filters required for the building flushout. These filters are to be installed after the flushout is completed.

3.06 LOW EMITTING MATERIALS

- A. IEQ Credit - Low Emitting Materials: Intent is to reduce concentrations of chemical contaminants that can damage air quality, human health, productivity and the environment.
1. Follow LEED instructions in LEED v4 Reference Guide.
 2. Contractor is required to complete and upload the following documentation to LEED Online:
 - a. USGBC low-emitting materials calculator (available at the project resources in LEED Online)
 - b. Product information (e.g., MSDS, third party certifications, testing reports, etc) for relevant materials
 3. Contractor is responsible for one of the following point options:
 - a. Option 1: Product Category threshold compliance in << 2 of the following categories (1 point), 4 of the following categories (2 points) or 5 of the following categories (3 points)>>:
 - 1) Interior paints and coatings applied onsite: 90% by volume for emissions, 100% VOC content
 - 2) Interior adhesives and sealants applied onsite (including flooring adhesive): 90% by volume for emissions and 100% for VOC content
 - 3) Flooring: 100% emissions
 - 4) Composite Wood: 100% emissions (separate Composite Wood Evaluation)
 - 5) Ceilings, walls, thermal and acoustic insulation: 100% emissions
 - 6) Furniture: 90% by cost (separate Furniture Evaluation)
 - b. Option 2: If some products in a category do not meet the criteria, use the Budget Calculation Method meeting << >=50% and <70% (1 point), >=70% and <90% (2 points) or >=90% (3 points)>> in any of the following categories:
 - 1) flooring,
 - 2) ceilings,
 - 3) walls,
 - 4) thermal and acoustic insulation or
 - 5) furniture.
 4. Composite Wood Evaluation - Composite wood, agrifiber products, and adhesives shall be made using ultra-low emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde. Salvaged and reused architectural millwork more than one year old at the time of occupancy is considered compliant, provided it meets the requirements for any site-applied paints, coatings, adhesives, and sealants.
 5. Furniture Evaluation - New furniture and furnishing items must be tested in accordance with ANSI/BIFMA Standard Method M7.1–2011. Comply with ANSI/BIFMA e3-2011 Furniture Sustainability Standard, sections 7.6.1 and 7.6.2, using either the concentration modeling approach or the emissions factor approach. Model the test results using the open plan, private office, or seating scenario in ANSI/BIFMA M7.1, as appropriate. USGBC-approved equivalent testing methodologies and contaminant thresholds are also acceptable. Salvaged and reused furniture more than one year old at the time of use is considered compliant, provided it meets the requirements for any site-applied paints, coatings, adhesives, and sealants.

6. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory for GBCI submission. Revisions and time to answer review questions should be assumed.

3.07 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT PLAN

- A. IEQ Credit Construction IAQ Management Plan: Intent is to promote the well-being of construction workers and building occupants by minimizing indoor air quality problems associated with construction and renovation. Contractor to include at a minimum the following elements into the plan:
 1. Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
 2. Prohibit the use of tobacco products inside the building and within 25 feet of the building entrances during construction.
 3. Protect absorptive materials stored on-site and installed from moisture damage.
 4. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 1 Section "Temporary Facilities and Controls", install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
 5. Replace all air filters immediately prior to occupancy.
- B. Provide record of compliance with Indoor Air Quality Management Plan:
 - a. Monthly photographs of equipment and ductwork protection.
 - b. Monthly photographs of filters used to protect air distribution and equipment.
 - c. Contractor's report documenting that MERV 8 filters were used to protect equipment during construction and filters meeting final design requirements were installed prior to occupancy.

3.08 INDOOR AIR QUALITY ASSESSMENT

- A. IEQ Credit – Indoor Air Quality Assessment: Intent is to establish better quality indoor air in the building after construction and during occupancy.
- B. Contractor is required to perform Option 1 path 1 or 2, or Option 2 as determined by the contract:
 1. Option 1, Path 1 (1 point): After construction ends, prior to occupancy and with all interior finishes and furniture installed, perform a building flush-out by supplying a total volume of 14000 cu. ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60 deg F and no higher than 80 deg F and a relative humidity no higher than 60 percent.
 2. Option 1, Path 2 (1 point): If occupancy is desired prior to flush-out completion, with furniture installed, the space may be occupied following delivery of a minimum of 3500 cu. ft. of outdoor air per sq. ft. of floor area to the space while maintaining an internal temperature of at least 60°F and no higher than 80°F and relative humidity no higher than 60%. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm per sq. ft. of outside air or the design minimum outside air rate determined in IEQ Prerequisite 1, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three (3) hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14000 cu. ft./sq. ft. of outside air has been delivered to the space.
 3. Option 2 (2 points) - Air-Quality Testing: If the Contractor chooses to test for compliance with this credit following is required, including contracting with an industrial hygienist to conduct testing:
 - a. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air," and as additionally detailed in the USGBC's "Green Building Design and Construction Reference Guide".
 - b. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:
 - 1) Formaldehyde: 27 ppb.
 - 2) Particulates (PM10): 50 micrograms/cu. m.
 - 3) Particulates (PM2.5): 15 micrograms/cu. m.
 - 4) Ozone: 0.075 ppm
 - 5) Total Volatile Organic Compounds (TVOC): 500 micrograms/cu. m.

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- 6) Target chemicals listed in CDPH Standard Method v1.1, Table 4-1, except formaldehyde -see supplement at end of this specification for table
 - 7) Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.
 - c. For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting non-complying building areas, samples are to be taken from the same locations as the first test.
 - d. Air-sample testing shall be conducted as follows:
 - 1) All measurements shall be conducted prior to occupancy but during normal occupied hours and with building ventilation system starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.
 - 2) Building shall have all interior finishes installed including, but not limited to, millwork, doors, paint, carpet, acoustic tiles and non-fixed furnishings such as workstations and partitions.
 - 3) Number of sampling locations will vary depending on the size of building and number of ventilation systems. For each portion of building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000 sq. ft. or for each contiguous floor area, whichever is larger, and shall include areas with the least ventilation and greatest presumed source strength.
 - 4) Air samples shall be collected between 3 and 6 feet from the floor to represent the breathing zone of occupants, and over a minimum four- hour period.
 4. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory for GBCI submission.

3.09 SUPPLEMENT

- A. The supplement listed below, up to "End of Section," is a part of this Specification:
 1. LEED BD&C v4.0 Project Checklist.
 - a. All credits listed for reference
 - b. Only Bold, Italic credits or prerequisites listed with a "C" are in the Scope of the Contractor. These are Construction Credits.
 - 1) All items identified as "D" are Design Credits.
 - 2) Credits identified as "D/C" are a combination of Design and Construction Credits and will require coordination.
 - c. All identified construction Prerequisites are required to be achieved to complete the certification process and are the responsibility of the Contractor. Care needs to be taken to ensure all prerequisites are awarded to the project.
 - d. All identified Construction Credits are required to be achieved and are the responsibility of the Contractor. Given certain point totals and project specific circumstances as the project progresses, with proper notice to the CPM, certain credits or credit point thresholds can be eliminated from the project. Written notice and approval is required.

LEED v4 for BD+C: New Construction and Major Renovation**Project Checklist**

Name: Madison Imagination Center at Reindahl Park

Address: 1818 Portage Road, Madison, WI 53704

Date: December 2, 2024

YES	NO	SCOPE			Possible Points	
	1	D	Credit	Integrative Process	1	
4	28		Location and Transportation			32
	16	D	Credit	LEED for Neighborhood Development Location		16
1		D	Credit	Sensitive Land Protection		1
1	1	D	Credit	High Priority Site		2
2	3	D	Credit	Surrounding Density and Diverse Uses		5
	5	D	Credit	Access to Quality Transit		5
	1	D	Credit	Bicycle Facilities		1
	1	D	Credit	Reduced Parking Footprint		1
	1	D	Credit	Green Vehicles		1
3	7		Sustainable Sites			10
Y		C	Prereq	Construction Activity Pollution Prevention		Required
1		D	Credit	Site Assessment		1
	2	D	Credit	Site Development - Protect or Restore Habitat		2
1		D	Credit	Open Space		1
	3	D	Credit	Rainwater Management		3
	2	D	Credit	Heat Island Reduction		2
1		D	Credit	Light Pollution Reduction		1
3	8		Water Efficiency			11
Y		D	Prereq	Outdoor Water Use Reduction		Required
Y		D	Prereq	Indoor Water Use Reduction		Required
Y		D	Prereq	Building-Level Water Metering		Required
2		D	Credit	Outdoor Water Use Reduction		2
1	5	D	Credit	Indoor Water Use Reduction		6
	2	D	Credit	Cooling Tower Water Use		2
	1	D	Credit	Water Metering		1
30	4		Energy and Atmosphere			33
Y		C	Prereq	Fundamental Commissioning and Verification		Required
Y		D	Prereq	Minimum Energy Performance		Required
Y		D	Prereq	Building-Level Energy Metering		Required
Y		D	Prereq	Fundamental Refrigerant Management		Required
6		C	Credit	Enhanced Commissioning		6
18		D	Credit	Optimize Energy Performance		18
	1	D	Credit	Advanced Energy Metering		1
	3	C	Credit	Demand Response		2
3		D	Credit	Renewable Energy Production		3
1		D	Credit	Enhanced Refrigerant Management		1
2		C	Credit	Green Power and Carbon Offsets		2

YES	NO	SCOPE			Possible Points
2	11		Materials and Resources		13
Y		D	Prereq	Storage and Collection of Recyclables	Required
Y		C	Prereq	Construction and Demolition Waste Management Planning	Required
	5	D	Credit	Building Life-Cycle Impact Reduction	5
	2	C	Credit	Building Product Disclosure and Optimization - Environmental Product Declarations	2
	2	C	Credit	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
	2	C	Credit	Building Product Disclosure and Optimization - Material Ingredients	2
2		C	Credit	Construction and Demolition Waste Management	2
10	6		Indoor Environmental Quality		16
Y		D	Prereq	Minimum Indoor Air Quality Performance	Required
Y		D	Prereq	Environmental Tobacco Smoke Control	Required
2		D	Credit	Enhanced Indoor Air Quality Strategies	2
2	1	C	Credit	Low-Emitting Materials	3
1		C	Credit	Construction Indoor Air Quality (IAQ) Management Plan	1
2		C	Credit	Indoor Air Quality (IAQ) Assessment	2
1		D	Credit	Thermal Comfort	1
1	1	D	Credit	Interior Lighting	2
1	2	D	Credit	Daylight	3
	1	D	Credit	Quality Views	1
	1	D	Credit	Acoustic Performance	1
5	1		Innovation		6
1		D/C	Credit 1.1	Innovation in Design: Green Cleaning Supplies	1
1		D/C	Credit 1.2	Innovation in Design: Integrated Pest Management	1
1		D/C	Credit 1.3	Innovation in Design: No Mercury Lighting	1
1		D/C	Credit 1.4	Innovation in Design: Occupant Comfort Survey	1
	1	D/C	Credit 1.5	Innovation in Design: Green Building Education	1
1		D	Credit 2	LEED Accredited Professional	1
2	2		Regional Priority		4
1		D/C	Credit	Regional Priority: Specific Credit - Sensitive Land	1
1		D/C	Credit	Regional Priority: Specific Credit - High Priority	1
	1	D/C	Credit	Regional Priority: Specific Credit	1
	1	D/C	Credit	Regional Priority: Specific Credit	1
59	68		TOTALS		Possible Points: 110

Certified: 40 to 49 points, Silver: 50 to 59 points, Gold: 60 to 79 points, Platinum: 80 to 110

2. Table 4-1 Target CREL VOCs and their maximum allowable concentrations:

No.	Compound Name	CAS No.	Allowable Conc.a (µg/m3)
1	Acetaldehyde	75-07-0	70
2	Benzene	71-43-2	30
3	Carbon disulfide	75-15-0	400
4	Carbon tetrachloride	56-23-5	20
5	Chlorobenzene	108-90-7	500
6	Chloroform	67-66-3	150
7	Dichlorobenzene (1,4-)	106-46-7	400
8	Dichloroethylene (1,1)	75-35-4	35
9	Dimethylformamide (N,N-)	68-12-2	40
10	Dioxane (1,4-)	123-91-1	1,500
11	Epichlorohydrin	106-89-8	1.5
12	Ethylbenzene	100-41-4	1,000
13	Ethylene glycol	107-21-1	200
14	Ethylene glycol monoethyl ether	110-80-5	35
15	Ethylene glycol monoethyl ether acetate	111-15-9	150
16	Ethylene glycol monomethyl ether	109-86-4	30
17	Ethylene glycol monomethyl ether acetate	110-49-6	45
18	n/a	n/a	n/a
19	Hexane (n-)	110-54-3	3,500
20	Isophorone	78-59-1	1,000
21	Isopropanol	67-63-0	3,500
22	Methyl chloroform	71-55-6	500
23	Methylene chloride	75-09-2	200
24	Methyl t-butyl ether	1634-04-4	4,000
25	Naphthalene	91-20-3	4.5
26	Phenol	108-95-2	100
27	Propylene glycol monomethyl ether	107-98-2	3,500
28	Styrene	100-42-5	450
29	Tetrachloroethylene	127-18-4	17.5
30	Toluene	108-88-3	150

31	Trichloroethylene	79-01-6	300
32	Vinyl acetate	108-05-4	100
33-35	Xylenes, technical mixture (m-, o-, p-xylene combined)	108-38-3, 95-47-6, 106-42-3	350

- (a) Refer to http://www.oehha.ca.gov/air/chronic_rels/AllChrels.html. All maximum allowable concentrations are one-half the corresponding CREL adopted by Cal/EPA OEHHA with the exception of formaldehyde. For any future changes in the CREL list by OEHHA, values in Table 4.1 shall continue to apply until these changes are published in the Standard Method.

END OF SECTION

**SECTION 01 91 00
COMMISSIONING (CX)**

PART 1 – GENERAL

1.01 SUMMARY

- A. Purpose: Define the responsibilities of the parties involved and the procedures related to the commissioning process

1.02 RELATED SPECIFICATIONS

- A. Section 01 31 13 - Project Management and Coordination.
- B. Section 01 31 19 - Project Meetings.
- C. Section 01 31 23 - Project Management.
- D. Section 01 32 26 - Construction Progress Reporting.
- E. Section 01 33 23 - Submittals.
- F. Section 01 45 16 - Field Quality Control.
- G. Section 01 77 00 - Closeout Procedures.
- H. Section 01 78 23 - Operation and Maintenance Data.
- I. Section 01 78 39 - As-Built Drawings.
- J. Section 01 79 00 - Demonstration and Training.
- K. Section 01 81 13 - Sustainable Design Requirements.
- L. Section 01 95 00 - Measurement & Verification.
- M. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.
- N. Section 23 09 00 - Instrumentation and Control for HVAC.
- O. Section 23 09 23 - Direct Digital Control (DDC) System for HVAC.
- P. Section 23 09 93 - Sequence of Operations for HVAC DDC.

1.03 REFERENCES

- A. ASHRAE Guideline 1.1-2007, "HVAC&R Technical Requirements for The Commissioning Process".
- B. ASHRAE Guideline 0-2013, "The Commissioning Process".
- C. ASTM E2947-16: Standard Guide for Building Enclosure Commissioning.
- D. ASTM E2813-12: Standard Practice for Building Enclosure Commissioning.
- E. NEBB – Procedural Standards for Building Systems Commissioning.

1.04 DEFINITIONS

- A. Acceptance Phase. Phase of construction after startup and initial checkout when functional performance tests are performed.
 - B. Commissioning Authority (CxA). An independent entity, not otherwise associated with the A/E team members or the Contractor and reports directly to the Owner. The CxA directs and coordinates the commissioning activities.
 - C. Commissioning Plan (Cx Plan). An overall plan, developed before or after bidding, that provides the structure, schedule and coordination planning for the commissioning process. The Cx Plan is included in the bid documents and is to be reviewed by all contractors before submitting their bid.
 - D. Contract Documents. The documents binding on parties involved in the construction of this project (drawings, specifications, change orders, amendments, contracts, Cx Plan, etc.).
 - E. Construction Checklist (CC). a list of items to inspect and test equipment and components to verify proper installation of equipment. The CCs are provided by the CxA to the Sub.
-

- F. Datalogging. - Monitoring flows, currents, status, pressures, etc. of equipment using stand-alone dataloggers separate from the control system.
- G. Deferred System Performance Tests. SPT's that are performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions that prevent the tests from being performed earlier.
- H. Deficiency. A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents (that is, does not perform properly or is not complying with the Owner's Project Requirements).
- I. Factory Testing. Testing of equipment on-site or at the factory by factory personnel with an Owner's representative present.
- J. Indirect Indicators. Indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100% closed.
- K. Manual Test. Using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").
- L. Monitoring. Recording parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of control systems.
- M. Over-written Value. Writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value from 75F to 50F to verify economizer operation). See also "Simulated Signal."
- N. Owner's Project Requirements (OPR). A document that describes what the Owner and stakeholders want to achieve with this project and what expectations they have of the completed project.
- O. Sampling. Reviewing or testing only a fraction of the total number of identical or near identical pieces of equipment.
- P. Seasonal Performance Tests. SPT's that are deferred until the system(s) will experience conditions closer to their design conditions.
- Q. Simulated Condition. Condition that is created for the purpose of testing the response of a system (e.g., applying a hair blower to a space sensor to see the response in a VAV box).
- R. Simulated Signal. Disconnecting a sensor and using a signal generator to send an amperage, resistance or pressure to the transducer and DDC system to simulate a sensor value.
- S. System Performance Test (SPT). Dynamic testing of entire systems (rather than just components of the system) under full operation.
- T. Trending. Monitoring of control points using the building automation system.

1.05 DESCRIPTION

- A. General: Commissioning (Cx) is a systematic process of verifying that all building systems perform interactively to meet the Owner's Project Requirements (OPR). This is achieved by beginning in the planning phase with documenting the OPR and continuing through design, construction, acceptance, and the warranty period with verification of performance. The Cx process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training. Cx during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:
 - 1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
 - 2. Verify and document proper performance of equipment and systems.
 - 3. Verify that O&M documentation is complete.
 - 4. Verify that the Owner's operating personnel are adequately trained.

- B. The Cx process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.
- C. The commissioning authority (CxA) has no authority to change, modify or direct any work. The CxA can only provide comments and suggestions.
- D. Commissioning Plan. The Cx Plan provides guidance in the execution of the Cx process. The CxA will update the Cx Plan regularly as the project progresses. The Drawings and Specifications will take precedence over the Cx Plan.

1.06 RESPONSIBILITIES

- A. General Contractor (GC) and Subcontractors (Subs)
 - 1. Construction and Acceptance Phase
 - a. Provide assistance to the Construction Manager CM in the coordination of the Cx work by the CxA, and with the CM and CxA ensure that Cx activities are being scheduled into the master schedule.
 - b. Provide an updated construction schedule to the CxA any time the schedule changes.
 - c. Include the Cx activities in the contract.
 - d. Furnish a copy of all submittals and shop drawings pertaining to the commissioned systems for review concurrently with the Architect and Engineers.
 - e. Furnish a copy of all construction meeting agendas and minutes to the CxA.
 - f. In each purchase order or subcontract written, include requirements for submittal data, O&M data, Cx tasks and training.
 - g. GC will ensure that all Subs execute their Cx responsibilities according to the Contract Documents and schedule.
 - h. A representative from the GC and each sub associated with the Cx process shall attend the Cx pre- construction meeting and the regular Cx meetings scheduled by the CxA to facilitate the Cx process.
 - i. Coordinate and execute the training of Owner personnel.
 - j. Prepare O&M manuals, according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
 - k. Prepare and submit draft forms, including but not limited to start-up procedures, Testing and Balancing (TAB) forms, calibration forms, etc. for review by the CxA before execution.
 - l. Submit test reports to the CxA of all tests performed on components and equipment to be commissioned that are not included as part of the Construction Checklist and SPT procedures.
 - m. Complete all construction checklist and functional performance test forms as required by the Cx process.
 - n. Support the CxA with verification of the completion of construction checklist and functional performance tests as outlined in PART 3.
 - o. Complete and inspect all installations. Certify that all components and systems are operating as intended per Contract Documents.
 - p. Remedy all deficiencies immediately as they are identified throughout construction.
 - q. Demonstrate functionality of all systems and equipment.
 - r. Maintain an updated set of record drawings (on a daily basis) on the construction site.
 - s. Provide support and instrumentation to verify TAB reports, start-up reports, calibration reports, and any other report pertinent to the commissioned equipment and systems.
 - t. Notify the CxA no less than 21 days before all testing, start-up, and training.
 - u. Update the CxA on a weekly basis on the progress of the Cx activities.
 - v. Submit trend data in electronic format or allow access to trending data by internet connection as requested by the CxA.
 - w. Install access points by every sensor such that the sensor can be calibrated without removal (P/T plugs, plugged holes in ducts etc.).
 - 2. Warranty Period

- a. Execute seasonal or deferred functional performance testing, witnessed by the CxA, according to the specifications.
 - b. Correct deficiencies and make necessary adjustments to O&M manuals and record drawings for applicable issues identified in any seasonal testing.
- B. Equipment Suppliers
 1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
 2. Assist in equipment testing per agreements with Subs.
 3. Include all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents in the base bid price to the Contractor, except for stand-alone data logging equipment that may be used by the CxA.
 4. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.
 5. Review test procedures for equipment installed by factory representatives.

1.07 SYSTEMS TO BE COMMISSIONED

- A. The entire Heating, Ventilation and Air Conditioning (HVAC) system (boilers, chillers, pumps, piping and air distribution systems).
- B. Building Automation System (BAS) for the HVAC system.
- C. Domestic Hot Water.
- D. Building envelope and roofing system.
- E. Lighting and Lighting Controls.
- F. Solar electric (PV) System.
- G. Solar hot water (SHW) System.
- H. Emergency Power System.

PART 2 – PRODUCTS

2.01 TEST INFORMATION

- A. All instruments needed to verify sensor readings, component performance, and system performance will be provided by GC and Subs and be available to the CxA. These instruments will not be beyond what the contractors need to complete the work specified in these construction documents. Any data logging equipment required in addition to the BAS will be provided by the CxA.
- B. All instruments shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Contract Documents. Refer to specification section 23 05 93 - Testing, Adjusting, and Balancing for required instrument tolerances.

PART 3 - EXECUTION

3.01 COMMISSIONING TEAM

- A. The members of the commissioning team consist of the Commissioning Authority (CxA), the Owner's Project Manager (PM), the designated representative of the Owner's Construction Management team (CM), the General Contractor (GC or Contractor), the architect and design engineers, the Mechanical Contractor, the Electrical Contractor, the TAB Contractor, the Controls Contractor, any other installing subcontractors or suppliers of equipment.
- B. Each Cx Team member shall designate one person who is responsible for coordinating the commissioning efforts with the CxA.

3.02 SCHEDULING AND MEETINGS

- A. Scheduling. The CxA will work with the other members of the Cx Team according to established protocols to schedule the Cx activities. The CxA will provide sufficient notice to the Cx Team for scheduling Cx activities. The GC will integrate all Cx activities into the master schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the Cx process.
- B. The CxA will provide the initial schedule of primary Cx events at the Cx pre-construction meeting. The Cx Plan provides a format for this schedule. As construction progresses more detailed schedules are developed by the CxA. The Cx Plan also provides a format for detailed schedules.
- C. Pre-Construction Meeting. Within 60 days of selection of the GC, the CxA will schedule, plan, and conduct a Cx pre-construction meeting with the entire Cx team in attendance. Meeting minutes will be distributed to all parties by the CxA. Information gathered from this meeting will allow the CxA to revise the Cx Plan which will also be distributed to all parties.
- D. Meetings. The Cx meetings will be scheduled approximately once a month during construction. These meetings will be scheduled directly before or after the regular construction meetings if practical. These meetings will cover coordination, deficiency resolution and planning issues with particular Subs. The CxA will plan these meetings and will minimize unnecessary time being spent by Subs

3.03 REPORTING

- A. The CxA will provide regular reports to the Owner as construction and Cx progresses. Standard forms are provided and referenced in the Cx Plan.
- B. The CxA will regularly communicate with all members of the Cx team, keeping them apprised of Cx progress and scheduling changes through memos, progress reports, etc.
- C. Testing or review approvals and non-conformance and deficiency reports are made regularly with the review and testing as described in later sections.

3.04 RECORD DRAWINGS

- A. The CxA will verify that the record drawings are updated throughout the construction. If a discrepancy is found between the record drawings and the installations, the CxA will notify the GC immediately. It is the GC and subcontractors responsibility to then inspect the installations and immediately and completely update the record drawings such that they accurately reflect the installation.

3.05 CONSTRUCTION COMMISSIONING PROCEDURES

- A. The following procedures apply to all equipment to be commissioned.
 - B. General. Construction checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that system performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full checkout. No sampling strategies are used. All construction checklists for a given system must be successfully completed prior to formal system performance testing of equipment or subsystems of the given system.
 - C. Construction Checklists.
 - 1. The primary purpose of the construction checklists is to provide the individual workers with the key criteria for a successful installation. The secondary purpose is to track the progress of the delivery and installation.
 - 2. The CxA will develop construction checklists for all commissioned equipment and distribute these to the responsible contractor. The GC and Subs will review the construction checklists for each equipment type and provide comments to the CxA. The CxA will then print and distribute the construction checklist for each individual component.
 - 3. The GC and Subs are responsible for all requirements in the specification, not only the requirements listed on the checklists.
 - 4. The checklists answer format will be to circle yes /no or provide a brief answer such as providing the model or serial numbers.
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5. These checklists are provided by the CxA to the GC. The GC determines which trade is responsible for executing and documenting each of the line item tasks and notes that trade on the form. Each form may have more than one trade responsible for its execution.
 6. The construction checklists shall be completed as delivery is completed and the installation progresses.
 7. Only individuals who have direct knowledge and witnessed that a line item task on the construction checklist was actually performed shall initial or check that item off. It is not acceptable for supervisors without direct knowledge or who have not witnessed the line item task on the construction checklist to fill out these forms.
 8. Any negative response shall immediately be brought to the attention of the CxA. All negative replies shall be explained in detail on the construction checklist.
 9. The GC and Subs are responsible for recording the completion of the checklists. Checklists shall be submitted electronically to SharePoint in .pdf format in separate files by Division. Each file shall be bookmarked by checklist tag.
 10. Non-itemized installations such as wiring, ductwork, piping etc. will not have checklists to be completed, but the GC and Subs will be provided the key criteria for successful installation.
 11. The CxA will verify the construction checklist completion by a sampling of the delivered and installed equipment. The sampling process will be described in the Cx Plan.
- D. Sensor Calibration. Calibration of all sensors shall be included as part of the construction checklists performed by the Contractors. Calibration information is provided in specification Section 23 09 23 - Direct Digital Control System for HVAC.
- E. Deficiencies, Non-Conformance and Approval in Checklists and Startup.
1. The Subs shall clearly list any outstanding items of the construction checklist that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are provided to the CxA within two days of task completion.
 2. The CxA reviews the report and submits either a non-compliance report or an approval form to the Sub or CM. The CxA shall work with the Subs and vendors to correct deficiencies or uncompleted items. The CxA will involve the CM and others as necessary. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CxA as soon as outstanding items have been corrected and include a Statement of Correction on the original non-compliance report. When satisfactorily completed, the CxA recommends approval of the completion of the checklists to the CM using a standard form.
 3. Items left incomplete, which later cause deficiencies or delays during functional testing may result in back charges to the responsible party.
- F. System Performance Tests (SPT). SPTs shall be performed to demonstrate that each system is operating according to the documented OPR and Contract Documents. System testing differs to the tests required in the Construction Checklist in that they facilitate bringing all the individual components together to verify that they operate collectively on a system level to provide the required design conditions.
1. Development of Test Procedures. The CxA shall prepare the SPT forms and procedures in accordance with the criteria defined in the Cx Plan. The GC and Subs shall assist the CxA in the preparation of these procedures by answering queries and forwarding site-specific information. A sample System Performance Test form is provided at the end of this specification section.
 2. Participation: The GC and the Subs are responsible for testing all systems to be commissioned such that they function as described in the contract documents. The CxA will verify the performance of the systems. The CxA will direct, witness and document the SPT verification and GC and Subs will execute the verification tests.
- G. Problem Solving. The CxA will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the GC, Subs and A/E.
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- H. Seasonal Testing. During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design) shall be completed as part of this contract. The CxA shall coordinate this activity. Tests will be executed, documented and deficiencies corrected by the appropriate Subs, with facilities staff and the CxA witnessing. Any final adjustments to the O&M manuals and record documents due to the testing will be made.
- I. Unforeseen Deferred Tests. If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon approval of the PM. These tests will be conducted in the same manner as the seasonal tests.

3.06 SENSOR AND ACTUATOR CALIBRATION

- A. Calibrate all field-installed temperature, relative humidity, carbon monoxide, carbon dioxide, and pressure sensors and gages, and all actuators (dampers and valves) on this piece of equipment shall be calibrated. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.
- B. Calibrate using the methods described below; alternate methods may be used, if approved by Owner beforehand. See PART 2 for test instrument requirements. Record methods used on the relevant Construction Checklist or other suitable forms, documenting initial, intermediate and final results.
- C. All Sensors:
 - 1. Verify that sensor location is appropriate and away from potential causes of erratic operation.
 - 2. Verify that sensors with shielded cable are grounded only at one end.
 - 3. For sensor pairs that are used to determine a temperature or pressure difference, for temperature make sure they are reading within 0.2 degree F (0.1 degree C) of each other, and for pressure, within tolerance equal to 2 percent of the reading, of each other.
 - 4. Tolerances for critical applications may be tighter.
- D. Sensors without Transmitters - Standard Application:
 - 1. Make a reading with a calibrated test instrument within 6 inches (152.4 mm) of the site sensor.
 - 2. Verify that the sensor reading, via the permanent thermostat, gage or building automation system, is within the tolerances in the table below of the instrument-measured value.
 - 3. If not, install offset, calibrate or replace sensor.
- E. Sensors with Transmitters - Standard Application.
 - 1. Disconnect sensor.
 - 2. Connect a signal generator in place of sensor.
 - 3. Connect ammeter in series between transmitter and building automation system control panel.
 - 4. Using manufacturer's resistance-temperature data, simulate minimum desired temperature.
 - 5. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter.
 - 6. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the building automation system.
 - 7. Record all values and recalibrate controller as necessary to conform with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction.
 - 8. Reconnect sensor.
 - 9. Make a reading with a calibrated test instrument within 6 inches (152.4 mm) of the site sensor.
 - 10. Verify that the sensor reading, via the permanent thermostat, gage or building automation system, is within the tolerances in the table below of the instrument-measured value.
 - 11. If not, replace sensor and repeat.
 - 12. For pressure sensors, perform a similar process with a suitable signal generator.
- F. Sensor Tolerances for Standard Applications: Plus/minus the following maximums:
 - 1. Watthour, Voltage, Amperage: 1 percent of design.
 - 2. Pressure, Air, Water, Gas: 3 percent of design.

3. Air Temperatures (Outside Air, Space Air, and Duct Air): 0.4 degrees Fahrenheit (-17.56 degrees Celsius).
 4. Relative Humidity: 4 percent of design.
 5. Barometric Pressure: 0.1 inch (2.54 mm) of Hg (340 Pa).
 6. Flow Rate, Air: 10 percent of design.
 7. Flow Rate, Water: 4 percent of design.
 8. Flow Rate, Steam: 3 percent of design.
 9. AHU Wet Bulb and Dew Point: 2 degrees Fahrenheit (-16.67 degrees Celsius).
 10. Hot Water Coil and Boiler Water Temperature: 1.5 degrees Fahrenheit (-16.94 degrees Celsius).
 11. Cooling Coil, Chilled and Condenser Water Temperatures: 0.4 degrees Fahrenheit (-17.56 degrees Celsius).
 12. Combustion Flue Temperature: 5 degrees Fahrenheit (-15 degrees Celsius).
 13. Oxygen and CO2 Monitors: 0.1 percentage points.
 14. CO Monitor: 0.01 percentage points.
 15. Natural Gas and Oil Flow Rate: 1 percent of design.
- G. Critical Applications: For some applications more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.
- H. Valve/Damper Stroke Setup and Check:
1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
 2. Set pump/fan to normal operating mode.
 3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
 4. Command valve/damper to open; verify position is full open and adjust output signal as required.
 5. Command valve/damper to a few intermediate positions.
 6. If actual valve/damper position does not reasonably correspond, replace actuator
- I. Isolation Valve or System Valve Leak Check: For valves not associated with coils.
1. With full pressure in the system, command valve closed.
 2. Use an ultra-sonic flow meter to detect flow or leakage.

3.07 NON-CONFORMANCE

- A. All deficiencies or non-conformance issues shall be noted and reported by the GC to the CM on a standard non-compliance form.
- B. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution will be documented on the procedure form.
- C. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the CM and the Owner.
- D. As tests progress and a deficiency is identified, the CxA discusses the issue with the executing contractor.
1. When there is no dispute on the deficiency and the Sub accepts responsibility to correct it:
 - a. The CxA documents the deficiency and the Sub's response and intentions and they go on to another test or sequence. After the day's work, the CxA submits the non-compliance reports to the CM for signature, if required. A copy is provided to the Sub and CxA. The Sub corrects the deficiency, signs the statement of correction at the bottom of the non-compliance form certifying that the equipment is ready to be retested and sends it back to the CxA.
 - b. The CxA reschedules the test and the test is repeated.
 - 1) If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:

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- c. The deficiency shall be documented on the non-compliance form with the Sub's response and a copy given to the CM and to the Sub representative assumed to be responsible.
 - d. Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the Project Manager.
 - e. The CxA documents the resolution process.
 - f. Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, signs the statement of correction on the non-compliance form and provides it to the CxA. The CxA reschedules the test and the test is repeated until satisfactory performance is achieved.
2. Cost of Retesting.
- a. The cost incurred by the Subs to retest a construction checklist item or functional test, if they are responsible for the deficiency, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated with the GC.
 - b. For a deficiency identified, not related to any construction checklist or start-up fault, the following shall apply: The CxA and CM will direct the retesting of the equipment once at no "charge" to the GC for their time. However, the CxA's and CM's time for a second retest will be charged to the GC, who may choose to recover costs from the responsible Sub.
 - c. The time for the CxA and CM to direct any retesting required because a specific construction checklist or start-up test item, reported to have been successfully completed, but determined during functional testing to be faulty, will be backcharged to the GC, who may choose to recover costs from the party responsible for executing the faulty installation or test.
 - d. The Contractor shall respond in writing to the CxA and CM at least as often as Cx meetings are being scheduled concerning the status of each apparent outstanding discrepancy identified during Cx. Discussion shall cover explanations of any disagreements and proposals for their resolution.
 - e. The CxA retains the original non-conformance forms until the end of the project.
 - f. Failure Due to Manufacturer Defect. If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable by the CM or PM. In such case, the Contractor shall provide the Owner with the following:
 - g. Within one week of notification from the CM or PM, the Contractor or manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the CM or PM within two weeks of the original notice.
 - h. Within two (2) weeks of the original notification, the Contractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation. The CM or PM will determine whether a replacement of all identical units or a repair is acceptable.
 - i. Two examples of the proposed solution will be installed by the Contractor and the CM will be allowed to test the installations for up to one week, upon which the CM or PM will decide whether to accept the solution.
 - j. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.
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- E. Approval. The CxA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the CxA and by the CM, if necessary. The CxA recommends acceptance of each test to the CM using a standard form. The CM gives final approval on each test using the same form, providing a signed copy to the CxA and the Contractor.

END OF SECTION

SECTION 01 91 19
BUILDING ENCLOSURE COMMISSIONING

PART 1 - GENERAL

1.01 REFERENCE STANDARDS

- A. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.
- B. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- C. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019 (Reapproved 2020).
- D. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015 (Reapproved 2023).

1.02 WORK INCLUDES

- A. Base Bid
 - 1. General Contractor
 - a. Assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities.
 - b. Provide field quality control testing and inspections on exterior enclosure construction (including filling out commissioning checklists) and submit reports to the Commissioning Agent.
 - c. Participate in testing/inspection procedures meetings.
 - d. Direct appropriate subcontractors to correct deficiencies as interpreted by the Commissioning Agent, Designer, and OWNER.
 - e. During construction, maintain as built redline drawings for all drawings.
 - f. Coordinate with manufacturers to determine specific requirements to maintain the validity of the warranty.
 - g. Provide input for final commissioning documentation to the Commissioning Agent.
 - h. Submit operation and maintenance data for systems, subsystems, and components to the Commissioning Agent.
 - i. Participate in maintenance orientation, training, and inspection.
 - j. Complete paper or electronic construction checklists as work is completed and provide to the CxA on a weekly basis.
 - k. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Using Agency to keep warranties in force.
 - l. Assist in equipment testing per agreements with General Contractor.
 - m. Provide all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents in the base bid price to the Contractor, except for stand-alone data logging equipment that may be used by the CxA.

1.03 SUMMARY

- A. This Section includes exterior enclosure commissioning procedures, including substructure, superstructure, exterior enclosure, and roofing construction that protects climate controlled interior space from unconditioned spaces and the exterior environment.
- B. Commissioning
 - 1. A systematic process ensuring that all building enclosure systems perform interactively according to the Architect's DN and the OPR. This is to be achieved through actual verification of systems performance during the construction period.

2. The commissioning process does not take away from, or reduce the responsibility of, the General Contractor and installing subcontractors to provide a finished and fully functioning product.
 3. Whole building commissioning includes heating, ventilation, electrical, and plumbing commissioning agents and building enclosure commissioning agents. This specification only addresses building enclosure commissioning.
- C. Building Envelope/Enclosure Commissioning Service Procurement: The OWNER shall retain a Building Envelope Commissioning Agent (BECxA), who will oversee the commissioning of all building enclosure components.
- D. Systems to be Commissioned: Sections of work to be commissioned are listed in the Cx Plan (reference Section 01 91 13 General Commissioning Requirements).
- E. Description: The steps involved in building enclosure commissioning and the services provided by the Building Envelope Commissioning Agent (BECxA) are described in the Cx Plan. (reference Section 01 91 13 General Commissioning Requirements)
- F. Abbreviations. The following are common abbreviations used in the Specifications and in the Commissioning Plan. Definitions are found in Section 1.3.

A/E	ARCHITECT AND DESIGN ENGINEERS	FMD	FACILITY MANAGEMENT DEPART.
CXA	COMMISSIONING AGENT	HC	HEATING CONTRACTOR
DN	DESIGN NARRATIVE	BECXA	BUILDING ENVELOPE CXA
CX	COMMISSIONING	OWNER	OWNER REPRESENTATIVE
CX PLAN	COMMISSIONING PLAN DOCUMENT	PM	PROJECT MANAGER (OF THE OWNER)
GC	GENERAL CONTRACTOR	RFI	REQUEST FOR INFORMATION
EC	ELECTRICAL CONTRACTOR	SUBS	SUBCONTRACTORS TO GENERAL
FPT	FUNCTIONAL PERFORMANCE TEST		

1.04 RELATED REQUIREMENTS:

- A. Section 01 91 13 - General Commissioning Requirements.

1.05 DEFINITIONS

- A. Acceptance Phase: Phase of construction after startup and initial checkout when functional performance tests, O&M documentation review and training occurs.
- B. Approval: Acceptance that a piece of equipment or system has been properly installed and is functioning in the tested modes according to the Contract Documents.
- C. Architect/Engineer (A/E): The prime consultant (architect) and sub-consultants who comprise the design team, generally the HVAC heating and ventilation designer/engineer and the electrical designer/engineer.
- D. DN: Design Narrative. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- E. CxA: Commissioning Agent. An independent agent, not otherwise associated with the A/E team members or the Contractor, hired by the OWNER. The CxA directs and coordinates the day-to-day commissioning activities.
- F. Cx Plan: Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

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- G. Data Logging: Monitoring flows, currents, status, pressures, etc. of equipment using stand-alone dataloggers separate from the control system.
 - H. Deferred Functional Tests: FPTs that are performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design, or other site conditions that disallow the test from being performed.
 - I. Deficiency: A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents (that is, does not perform properly or is not complying with the design intent)
 - J. Design Intent: A dynamic document that provides the explanation of the ideas, concepts and criteria that are considered to be very important to the OWNER. It is initially the outcome of the programming and conceptual design phases.
 - K. Design Narrative or Design Documentation: Sections of either the Design Intent or Design Narrative.
 - L. Factory Testing: Testing of equipment on-site or at the factory-by-factory personnel with Owner representative present.
 - M. Functional Performance Test (FPT): Test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not functional testing, in the commissioning sense of the word. TAB's primary work is setting up the system flows, and pressures as specified, while functional testing is verifying that which has already been set up. The Commissioning Agent develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing contractor or vendor. FPTs are performed after prefunctional checklists and startup are complete.
 - N. General Contractor (GC): The prime contractor for this project. Generally, refers to all the GC's subcontractors as well. Also referred to as the Contractor, in some contexts.
 - O. Indirect Indicators: Indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100% closed.
 - P. Manual Test: Using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").
 - Q. Monitoring: The recording of parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of control systems.
 - R. Non-Compliance: See Deficiency.
 - S. Non-Conformance: See Deficiency.
 - T. Over-written Value: Writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value from 50F to 75F to verify economizer operation). See also "Simulated Signal."
 - U. OPR: Owner Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information. For clarity, the OPR here refers to the OWNER project requirements.
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- V. Pre-Functional Checklist (PC): A list of items to inspect and elementary component tests to conduct to verify proper installation of equipment, provided by the CxA to the Sub. Prefunctional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, etc.). However, some prefunctional checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three-phase pump motor of a chiller system). The word prefunctional refers to before functional testing. Pre-functional checklists augment and are combined with the manufacturer's start-up checklist. Even without a commissioning process, contractors typically perform some, if not many, of the prefunctional checklist items a Commissioning Agent will recommend. However, few contractors document in writing the execution of these checklist items. Therefore, for most equipment, the contractors execute the checklists on their own. The Commissioning Agent only requires that the procedures be documented in writing, and does not witness much of the prefunctional checklist, except for larger or more critical pieces of equipment.
- W. Sampling: Functionally testing only a fraction of the total number of identical or near identical pieces of equipment.
- X. Seasonal Performance Tests: FPTs that are deferred until the system(s) will experience conditions closer to their design conditions.
- Y. Simulated Condition: Condition that is created for the purpose of testing the response of a system (e.g., applying a hair blower to a space sensor to see the response in a VAV box).
- Z. Simulated Signal: Disconnecting a sensor and using a signal generator to send an amperage, resistance or pressure to the transducer and DDC system to simulate a sensor value.
- AA. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.
- BB. Startup: The initial starting or activating of dynamic equipment, including executing prefunctional checklists.
- CC. Subs: The subcontractors to the GC who provide and install building components and systems.
- DD. Test Procedures: The step-by-step process which must be executed to fulfill the test requirements. The test procedures are developed by the CxA.
- EE. Test Requirements: Requirements specifying what modes and functions, etc. shall be tested. The test requirements are not the detailed test procedures. The test requirements are specified in the Contract Documents
- FF. Trending: Monitoring using the building control system.
- GG. Vendor: Supplier of equipment.
- HH. Warranty Period: Warranty period for entire project, including equipment components. Warranty begins at Substantial Completion and extends for at least one year, unless specifically noted otherwise in the Contract Documents and accepted submittals.

1.06 1.5 COORDINATION

- A. Commissioning Team. The members of the commissioning team consist of the Commissioning Agent (CxA), the Owner Representative, the designated representative of the Owner Construction Management firm (CM), the General Contractor (GC or Contractor), the architect and design engineers (particularly the heating and ventilation engineers), the Heating Contractor (HC), the Ventilation Contractor (VC), the Electrical Contractor (EC), and any other installing subcontractors or suppliers of equipment. If known, the Owner building or plant operator/engineer is also a member of the commissioning team.
- B. Management. The CxA is hired by the OWNER directly. The CxA directs and coordinates the commissioning activities and the reports to the OWNER. All members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents.

- C. Scheduling. The CxA will work with the GC according to established protocols to schedule the commissioning activities. The CxA will provide sufficient notice to the GC for scheduling commissioning activities. The GC will integrate all commissioning activities into the master schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.
- D. The CxA will provide the initial schedule of primary commissioning events at the commissioning scoping meeting. The Commissioning Plan provides a format for this schedule. As construction progresses, more detailed schedules are developed by the CxA. The Commissioning Plan also provides a format for detailed schedules.

1.07 COMMISSIONING PROCESS

- A. Commissioning Plan. The Commissioning Plan, provided as part of the bid documents, is binding on the Contractor. The commissioning plan provides guidance in the execution of the commissioning process. Just after the initial commissioning scoping meeting the CxA will update the plan which is then considered the “final” plan, though it will continue to evolve and expand as the project progresses. The Specifications will take precedence over the Commissioning Plan.
- B. Commissioning Process. See the Commissioning Plan for an overview of the commissioning tasks during construction and the order in which they occur.

1.08 COMMISSIONING TEAM

- A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, the General Contractor (GC) and representatives of the Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.
- B. Members Appointed by OWNER:
 - 1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process.
 - 2. Representatives of the facility user and operation and maintenance personnel.
 - 3. The OWNERs Representative.
 - 4. Architect and engineering design professionals.

1.09 OWNER RESPONSIBILITIES

- A. Provide the OPR documentation to the CxA and Contractor for information and use.
- B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
- C. Provide the DN documentation, prepared by Architect, and approved by OWNER, to the CxA and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.
- D. Follow the Commissioning Plan.
- E. Attend commissioning scoping meetings and additional meetings as necessary.

1.10 ARCHITECT/ENGINEERS (AE) RESPONSIBILITIES

- A. The AE shall participate in and perform commissioning process activities including the following:
 - 1. Attend the commissioning scoping meeting and selected commissioning team meetings.
 - 2. Perform normal submittal review, construction observation, as-built drawing preparation, O&M manual preparation, etc., as contracted.
- B. Provide paper and electronic copies of Project Drawings and specifications to the Commissioning Agent.
- C. Attend the commissioning scoping meeting and selected commissioning team meetings.

- D. Perform normal submittal review, construction observation, as-built drawing preparation, O&M manual preparation, etc., as contracted.
- E. Provide any design narrative and sequence documentation requested by the CxA. The designers shall assist (along with the contractors) in clarifying the operation and control of the building enclosure component in areas where the specifications, drawings or documentation is not sufficient for writing detailed testing procedures.
- F. Participate in testing/inspection procedures meetings.
- G. Coordinate resolution of system deficiencies identified during commissioning, according to the contract documents. Provide written responses to design review comments from the Commissioning Agent or other parties as requested.
- H. Prepare and submit final as-built design intent documentation for inclusion in the O&M manuals. Review and approve the O&M manuals.
- I. Coordinate resolution of design non-conformance and design deficiencies identified during warranty-period commissioning of which the Commissioning Agent and Contractor may disagree.

1.11 GENERAL CONTRACTOR'S RESPONSIBILITIES (OR "PRIME CONTRACTOR", IF APPLICABLE)

- A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including the following:
 - 1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
 - 2. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
 - 3. Attend commissioning team meetings held as needed.
 - 4. Integrate and coordinate commissioning process activities with construction schedule.
 - 5. Review commissioning progress and deficiency reports.
 - 6. Review and accept construction checklists provided by the CxA.
- B. Provide Coordination Drawings (see Section 1.12 Building Enclosure Coordination Documents) showing the complete coordination and integration of all work of commissioned envelope systems to the Commissioning Agent.
- C. Provide cut sheets and Shop Drawings Submittals of commissioned systems to the Commissioning Agent.
- D. Attend Preconstruction, Design, and Construction Phase building enclosure coordination meetings.
- E. Provide Test Data, Letters of Compatibility, and Certificates to the Commissioning Agent.
- F. Coordinate trades in accordance with the requirements in the General Conditions and General Requirements of the Construction Contract.
- G. Permit and provide access to locations of installed systems, subsystems, and components for testing and inspection
- H. Review test procedures to ensure feasibility, safety and equipment protection and provide necessary written limits to be used during tests.
- I. Provide schedule and accommodate field quality control tests and inspections required by the Contract Documents and product manufacturers to the Commissioning Agent.
- J. Upgrade schedule biweekly throughout the construction period.
- K. Provide field quality control testing and inspections on exterior enclosure construction (including filling out commissioning checklists) and submit reports to the Commissioning Agent.
- L. Participate in testing/inspection procedures meetings.
- M. Direct appropriate subcontractors to correct deficiencies as interpreted by the Commissioning Agent, Designer, and OWNER.
- N. During construction, maintain as built redline drawings for all drawings.

- O. Coordinate with manufacturers to determine specific requirements to maintain the validity of the warranty.
- P. Provide input for final commissioning documentation to the Commissioning Agent.
- Q. Submit operation and maintenance data for systems, subsystems, and components to the Commissioning Agent
- R. Participate in maintenance orientation, training, and inspection.

1.12 SUB CONTRACTOR'S RESPONSIBILITIES

- A. The CxA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The CxA may assist with problem-solving non-conformance or deficiencies, but ultimately that responsibility resides with the general contractor and the A/E. The primary role of the CxA is to develop and coordinate the execution of a testing plan, observe and document performance—that systems are functioning in accordance with the documented design intent and in accordance with the Contract Documents. The Contractors will provide all tools or the use of tools to start, check-out and functionally test equipment and systems.
 - 1. Coordinates and directs the commissioning activities using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.
 - 2. Coordinate the commissioning work and, with the GC, ensure that commissioning activities are being scheduled into the master schedule.
 - 3. Revise, as necessary, the Commissioning Plan.
 - 4. Plan and conduct a commissioning scoping meeting and other commissioning meetings.
- B. Incorporate commissioning requirements into the Construction Documents via a commissioning specification.
- C. Initial review of preliminary Construction Documents against OPR and DN.
- D. Perform back check review of Construction Documents against OPR and DN.
- E. Develop functional Test Plan for exterior enclosure.
- F. Review of Project Drawings and Specifications at 50%, and 100% completion for constructability, durability, and performance of exterior enclosure conformance.
- G. Review of pertinent building enclosure Shop Drawings/Submittals for compliance with
- H. Observe the construction and testing of mockups (if applicable).
- I. Document construction of commissioned components at the completion of mockup testing. This documentation will consist of graphic representation of mockup details for use in revising shop drawings as needed (if applicable).
- J. Attend pertinent Progress Meetings (as needed).
- K. Perform field observations of exterior enclosure installations.
- L. Maintain a log of deficient conditions.
- M. Observe functional field performance (in-situ) testing.
- N. Evaluate substitution requests for compliance with Contract Documents and for compatibility with work of other subcontractors.
- O. Compile test data, inspection reports, and certificates and include them in the Systems Manual and Commissioning Process Report.
- P. Recommend resolution of conflicts in the installation of materials and assemblies specific to the building enclosure trades.
- Q. Finalize Commissioning Record with warranties and closeout documentation.

- R. Verify applicable training procedures of building maintenance personnel.

1.13 BUILDING ENCLOSURE COORDINATION DOCUMENTS

- A. The General Contractor shall be fully responsible for coordinating all trades, assuring proper construction sequences and schedules, and coordinating the actual installed location and interface of all work that impacts the building enclosure. Before materials are fabricated or the work begun, the General Contractor shall supervise and direct the creation of one set of Coordination Drawings showing the complete coordination and integration of all work of this Project relating to the thermal, drainage, air barrier, vapor barrier, and waterproofing systems of enclosure. Coordination Drawings are intended to assist the General Contractor during construction, and may be produced using Architect's drawings, shop drawings, or other drawings as needed to communicate coordination requirements to all concerned subcontractors. Specifically, Coordination Drawings shall include, but are not limited to the following detail conditions and system connections. See applicable divisions for further requirements.
1. Cold fluid applied water proofing
 2. Thermal insulation
 3. Weather barriers
 4. Fluid applied membrane air barriers
 5. Metal composite wall panel joints
 6. Preformed metal siding
 7. Joint sealants
 8. TPO roofing
 9. Sheet metal flashing and trim
 10. Roof accessories
 11. Roof-to-wall metal flashing terminations
 12. Roof-to-wall flashing conditions at all locations
 13. Precast concrete panel tie-in to adjacent waterproofing/air barrier membranes
 14. Roofing system penetrations
 15. Flashing at fenestrations and doors

1.14 FUNCTIONAL PERFORMANCE TESTING (IN-SITU)

- A. Objectives and Scope: The objective of functional performance testing is to demonstrate that each building enclosure/assembly system is operating according to the documented design intent of the Contract Documents and in accordance with the OPR. Functional testing facilitates bringing the material assembly from a state of substantial completion to full operation. Additionally, during the testing process, areas of non-compliant performance are identified and corrected, improving the operation, and function of the building enclosure/assemblies.
- B. Development of Test Plans: The subcontractors / testing agents shall develop project-specific test plans for each building enclosure/assembly to meet the testing requirements including pass criteria and schedule as specified in Part 3.2 of this section (01 91 19). Prior to execution, the BECxA shall review the test plans.
1. The test plans shall include, but not be limited to the following:
 - a. Who will perform the test?
 - b. Specific locations and sampling rates
 - c. Prerequisites to be fulfilled before the testing
 - d. Test set-up procedures
 - e. Passing criteria
 2. The BECxA shall observe contractor-provided performance testing.
 3. The General Contractor, according to the requirements / direction of the Testing Agent, shall construct or arrange for construction of test chambers and shall provide staging and access equipment as needed to position spray racks at the exterior.

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4. The purpose of any given specific test is to verify and document compliance with the stated criteria of the Construction Documents.
- C. Test Methods
1. Functional performance testing and verification will typically follow ASTM industry standards. The subcontractor will determine which method is most appropriate for tests and modify test methods when an existing industry method is not available or applicable.
 2. Simulated Conditions: Simulating conditions may be allowed as needed, though testing actual conditions is encouraged wherever practical.
- D. Coordination and Scheduling: The General Contractor and their subcontractors shall provide sufficient notice to the Commissioning Agent regarding their completion schedule for the functional checklists and construction of the assemblies or building enclosure systems. The General Contractor will schedule functional tests with the BECxA and affected subcontractors.
- E. In general, functional testing is conducted after mockup testing has been satisfactorily completed.
- F. Problem Solving: The BECxA may recommend solutions to problems found, however, the burden of responsibility to solve, correct, and retest problems is with the contractor responsible for the installation of the tested assembly.
- G. Failed tests will typically result in additional testing of the failed specimen. The cost of re-staging and constructing test chamber shall be responsibility of the deficient contractor. Costs for subsequent retests due to failure shall be the responsibility of the deficient contractor. Test will be concluded only when satisfactory results are achieved.
- H. Non-Conformance:
1. The subcontractor will record the results of the functional tests in a written report. All deficiencies or non-conformance issues shall be noted and reported.
 2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the BECxA. In such cases, the deficiency and resolution will be documented in the written report.
 3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures.
 4. As tests progress and a deficiency is identified, the issues are discussed with the executing Contractor.
 - a. When there is no dispute on the deficiency and the subcontractor accepts responsibility to correct it:
 - 1) The BECxA documents the deficiency and the subcontractor's response and intentions and work proceeds.
 - 2) The BECxA will coordinate the rescheduled test with the affected Contractor, and the test is repeated.
 - 3) Work associated with any envelope system or component that fails testing will immediately cease until testing non-conformances/failure are corrected, and re-testing proves successful.
 - b. If there is a dispute about a deficiency regarding whether it is a deficiency or who is responsible:
 - 1) The deficiency shall be documented on the Non-Compliance Form with the subcontractor's response and copy give to the General Contractor and to the subcontractor's representative assumed to be responsible.
 - 2) Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Interpretive authority is with the A/E. Final acceptance authority is with the PM.
 - 3) The BECxA documents the resolution process.
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- 4) Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, signs the Statement of Correction on the Non- Compliance form, and provides it to the BECxA. The General Contractor shall reschedule the test with the affected Contractors, and the test(s) are repeated until satisfactory performance is achieved.
- 5) Any required retesting that is a result of deficient installation shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.
- 6) Work associated with any envelope system or component that fails testing will immediately cease until testing non-conformances/failure are corrected, and re-testing proves successful.
- 7) Deficiencies identified through inspections and/or testing are to be corrected by the executing Contractor at their expense.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 MEETINGS

- A. Scoping Meeting. Within 90 days of commencement of construction, the CxA will schedule, plan and conduct a commissioning scoping meeting with the entire commissioning team in attendance. Meeting minutes will be distributed to all parties by the CxA. Information gathered from this meeting will allow the CxA to revise the Commissioning Plan to its "final" version, which will also be distributed to all parties.
- B. Miscellaneous Meetings. Other meetings will be planned and conducted by the CxA as construction progresses. These meetings will cover coordination, deficiency resolution and planning issues with particular Subcontractors. The CxA will plan these meetings and will minimize unnecessary time being spent by Subs. These meetings may be held monthly or weekly as required or as the end of construction draws closer.

3.02 ONSITE TESTING

- A. All labor, materials, and testing equipment for building enclosure test preparation, execution, and re-testing to be provided by contractor as part of base bid.
- B. This section includes a summary of all required enclosure testing (not excluding inspections).
 1. Testing Standards:
 - a. ASTM E 1186-03, (Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier System.) Section 4.2.7 (Chamber Depressurization in Conjunction with Leak Detection Liquid.)
 - 1) Applicable Sections:
 - (a) 07 25 00 – Weather Barriers
 - (b) 07 53 00 – Elastomeric Membrane Roofing
 - 2) Test Schedule: After all specified coats of fluid barrier applied or membrane adhered and manufacturer's required curing time has elapsed, before installation of exterior continuous insulation
 - 3) Test Quantity: 2 sets of 25 per barrier type, as directed by Owner, BCxP, and Architect
 - 4) Pass Criteria: no visible bubbles in the testing fluid
 - b. ASTM D 4541-95, (Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.)
 - 1) Applicable Sections:
 - (a) 07 25 00 – Weather Barriers (Building Wrap Only)
 - 2) Test Schedule: After all specified coats of air barrier are applied and cured, before the installation of exterior cladding.
 - 3) Test Quantity: Minimum 3 locations per barrier type, as directed by Owner, BCxP, and Architect
 - 4) Pass Criteria: 5% greater than manufacturer's stated ultimate elongation

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- c. AAMA 501.2, (Quality Assurance and Diagnostic Water Leakage Field Check)
 - 1) Applicable Sections:
 - (a) 07 42 13.23 – Metal Composite Material Wall Panels
 - (b) 07 42 33 – Phenolic Wall Panels
 - (c) 08 41 14 – Aluminum-Framed Storefronts
 - 2) Test Schedule: At 10% and 50% installation completion, prior to installation of interior finishes, performing out of sequence work as required to facilitate testing schedule.
 - 3) Test Quantity: 200' linear per round (up to 400' total), as directed by Owner, BCxP, and Architect
 - 4) Pass Criteria: No visible water intrusion
 - d. ASTM E7877 (Standard Guide for Electronic Methods for Detecting and Locating Leaks in Waterproof Membranes, low-voltage)
 - 1) Applicable Sections:
 - (a) 07 53 00 – Elastomeric Membrane Roofing
 - 2) Test Schedule: At 10% membrane installation completion, after membrane adhered, joints taped/waterproofed, and manufacturer's required curing time has elapsed, before installation of exterior continuous insulation
 - 3) Test Quantity: 2 tests, as directed by Owner, BCxP, and Architect
 - 4) Pass Criteria: No leaks detected
 - e. ASTM D 8231 – 19, (Standard Practice for the Use of a Low Voltage Electronic Scanning System for Detecting and Locating Breaches in Roofing and Waterproofing Membranes)
 - 1) 07 53 00 – Elastomeric Membrane Roofing
 - 2) Test Schedule: At 100% membrane installation completion, after membrane adhered, joints taped/waterproofed, and manufacturer's required curing time has elapsed, before installation of exterior continuous insulation
 - 3) Test Quantity: 1 test
 - 4) Pass Criteria: No leaks detected
 - f. ASTM C1193, Method A (Field-Applied Sealant Joint Hand Pull Tab) – OR – ASTM C1521, Method A (TaiProcedure)
 - 1) Applicable Sections:
 - (a) 07 92 00 – Joint Sealants
 - 2) Test Schedule: After joint sealant applied and cured, before the installation of exterior cladding.
 - 3) Test Quantity: 10 tests for the first 1000' of joint length for each unique combination of sealant and substrate, and 1 test per 1000' thereafter.
 - 4) Pass Criteria: 5% greater than manufacturer's stated ultimate elongation
 - g. ASTM E 783 (Field Measurement of Air Leakage Through Installed Exterior Windows and Doors) Per Section 014350, Part 3.1.B.3.i)
 - 1) Applicable Sections:
 - (a) 08 11 13 – Hollow Metal Doors (exterior doors only)
 - (b) 08 31 00 – Access Doors and Frames
 - (c) 08 41 14 – Aluminum-Framed Storefronts
 - 2) Test Schedule: At the mockup and 10%, 30%, and 70% installation completion (4 rounds of testing total), performing out of sequence work as required to facilitate testing schedule.
 - 3) Test Quantity: 2 openings per round, not exceeding the total number of openings per type (8 total, or all openings of a given type, if less than 8 of that type are present), as directed by Owner, BCxP, and Architect
 - 4) Pass Criteria:
 - (a) Storefront: 0.15 cfm/sf at 6.27 PSF test pressure
 - (b) Exterior Doors, other than overhead: 0.15 cfm/sf at 6.27 PSF test pressure
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- h. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference
- 1) Applicable Sections:
 - (a) 08 11 13 – Hollow Metal Doors (exterior doors only)
 - (b) 08 31 00 – Access Doors and Frames
 - (c) 08 41 14 – Aluminum-Framed Storefronts
 - 2) Test Schedule: At the mockup and 10%, 30%, and 70% installation completion (4 rounds of testing total), performing out of sequence work as required to facilitate testing schedule.
 - 3) Test Quantity: 2 openings per round, not exceeding the total number of openings per type (8 total, or all openings of a given type, if less than 8 of that type are present), as directed by Owner, BCxP, and Architect
 - 4) Pass Criteria:
 - (a) Storefront: 0.15 cfm/sf at 6.27 PSF test pressure
 - (b) Exterior Doors, other than overhead: 0.15 cfm/sf at 6.27 PSF test pressure
 - (c) Overhead Doors: 0.60 cfm/sf at 1.57 PSF test pressure
 - 5) ASTM E 779, (Standard Test Method for Determining Air Leakage Rate by Fan Pressurization) – OR – ASTM E 1827 (Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door)
 - 6) Test Schedule:
 - (a) Perform test twice:
 - (1) At mid-construction after completion of exterior air barrier, but prior to interior finishes to permit diagnosis upon test failure, performing out of sequence work as required to facilitate testing schedule.
 - (2) Just prior to substantial completion.
 - 7) Pass Criteria: 0.1 cfm / sqft at 50 Pa test pressure.
- C. In case of discrepancy between testing specified in Section 01 91 19 and elsewhere in the project manual, the more stringent requirement shall apply (e.g. if a test is specified elsewhere but not in Section 01 91 19, the test is required shall be required; if a test is specified in Section 01 91 19 but not elsewhere, the test shall be required; if a test is specified elsewhere without a specific quantity or schedule, and in this section with a specific quantity and schedule, the requirement from Section 01 91 19 shall apply).

3.03 REPORTING

- A. The CxA will communicate with all members of the commissioning team, keeping them apprised of commissioning progress and scheduling changes through memos, progress reports, etc.
- B. Testing or review approvals and non-conformance and deficiency reports are made with the review and testing as described in later sections.
- C. A final summary report by the CxA will be provided to the GC and OWNER. All acquired documentation, logs, minutes, reports, deficiency lists, communications, findings, unresolved issues, Prefunctional checklists, functional tests, monitoring reports, etc. will be compiled in appendices and provided with the summary report.

END OF SECTION

SECTION 01 95 01
MONITORING-BASED COMMISSIONING

PART 1 – GENERAL

1.01 SUMMARY

- A. Purpose: This section includes general requirements that apply to implementation of monitoring-based commissioning (MbCx). MbCx is a component of the LEED v4.1 Rating System and the Commissioning Process. This process replaces the Measurement and Verification process that was used in the LEED v3 Rating System.
- B. RELATED WORK AND REQUIREMENTS
 - 1. Section 01 31 13 - Project Coordination.
 - 2. Section 01 31 19 - Project Meetings.
 - 3. Section 01 31 23 - Project Management Web Site.
 - 4. Section 01 91 00 - Commissioning (Cx).
 - 5. Section 23 09 00 - Instrumentation and Control for HVAC.
 - 6. Section 23 09 23 - Direct Digital Control (DDC) System for HVAC.
 - 7. Section 23 09 93 - Sequence of Operations for HVAC DDC.
 - 8. Section 26 24 13 - Switchboards.
 - 9. Section 26 24 16 - Panelboards.

1.02 DEFINITIONS

- A. BAS - Building Automation System.
- B. Cx - Commissioning.
- C. DHW - Domestic Hot Water.
- D. MbCx Monitoring-Based Commissioning.
- E. kW - Electric power read from utility meter.
- F. KWh - Electric energy consumption read from utility meter.
- G. Plug Loads – Electric power and consumption from wall receptacles.

1.03 MECHANICAL CONTRACTOR RESPONSIBILITIES

- A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform MbCx activities including, but not limited to, the following:
 - 1. Follow activities identified in the Cx Plan.
 - 2. Coordinate connection of gas and DHW monitoring equipment with BAS.
 - 3. Cooperate with the Cx Agent, owner, Electrical Contractor and Controls Contractor for resolution of issues related to data collection.
 - 4. Attend team meetings during construction and post-construction MbCx period (1 year). Attend quarterly meetings.
 - 5. Followup training or repairs needed to maintain performance.

1.04 ELECTRICAL CONTRACTOR RESPONSIBILITIES

- A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform MbCx activities including, but not limited to, the following:
 - 1. Follow activities identified in the Cx Plan.
 - 2. Coordinate connection of electrical monitoring equipment with BAS
 - 3. Cooperate with the Cx Agent, owner, Mechanical Contractor and Controls Contractor for resolution of issues related to data collection.
 - 4. Attend team meetings during construction and post-construction MbCx period (1 year). Attend quarterly meetings.
 - 5. Followup training or repairs needed to maintain performance.

1.05 CONTROLS CONTRACTOR RESPONSIBILITIES

- A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform MbCx activities including, but not limited to, the following:
1. Follow activities identified in the Cx Plan.
 2. Coordinate connection of electrical monitoring equipment with BAS
 3. Coordinate connection of gas and DHW monitoring equipment with BAS.
 4. Coordinate connection of measurement requirements (points, data access) with BAS.
 5. Cooperate with the Cx Agent, owner, Mechanical Contractor and Electrical Contractor for resolution of issues related to data collection.
 6. Attend team meetings during construction and post-construction MbCx period (1 year). Attend quarterly meetings.
 7. Followup training or repairs needed to maintain performance.

1.06 MBCX PROVIDERS RESPONSIBILITIES

- A. The Cx Agents responsibilities related to MbCx include:
1. Organize and lead the MbCx team.
 2. Provide a Cx plan that includes the following procedures and information:
 - a. roles and responsibilities as they relate to MbCx;
 - b. measurement requirements (meters, points, metering systems, data access);
 - c. the points to be tracked, with frequency and duration for trend monitoring;
 - d. the limits of acceptable values for tracked points and metered values (where appropriate, predictive algorithms may be used to compare ideal values with actual values);
 - e. the elements used to evaluate performance, including conflict between systems, out-of-sequence systems components, and energy and water usage profiles;
 - f. an action plan for identifying and correcting operational errors and deficiencies;
 - g. training to prevent errors;
 - h. planning for repairs needed to maintain performance; and
 - i. the frequency of analyses in the first year of occupancy (at least quarterly).
 3. Convene MbCx meetings as needed, but at least quarterly for 1 year post construction.
 4. Cooperate with the Mechanical Contractor, Electrical Contractor, and Controls Contractor for resolution of issues related to establishing connection between BAS and monitoring meters and equipment.
 5. Provide a final MbCx report at 1 year post construction.
 6. Update the systems manual with any modifications or new settings, and give the reason for any modifications from the original design.

PART 2 – PRODUCTS**2.01 METERS AND SUB-METERS**

- A. Monitoring meters and sub-meters, both gas and electric, to have the ability to connect to the BAS and provide data to BAS at a minimum of 15 minute intervals. It is acceptable to use the utility for this purpose if allowable by utility company.

PART 3 - EXECUTION**3.01 ELECTRIC METER**

- A. Provide real-time monitoring of the whole building electricity kW and kWh use by using a signal from the building utility meter serving the HVAC, lighting, and plug loads and provide the data input to the Building Automation System (BAS). The BAS must be capable of trending this kW and kWh data. Data is to be collected in 15 minute intervals. Storage of at least 3 months of 15 minute data is required on the BAS. Data older than 3 months is to be automatically saved and archived on the BAS computer without being overwritten. Data older than 5 years can be overwritten. It is the responsibility of the electrical contractor to coordinate this work.

3.02 ELECTRIC SUB-METERS

- A. Provide real-time monitoring of the building electricity kW and kWh use by using a signal from the building panel sub-meters at each floor and provide the data input to the BAS. The BAS must be capable of trending this kW and kWh data. Data is to be collected in 15 minute intervals. Storage of at least 3 months of 15 minute data is required on the BAS. Data older than 3 months is to be automatically saved and archived on the BAS computer without being overwritten. Data older than 5 years can be overwritten. It is the responsibility of the electrical contractor to coordinate this work.

3.03 NATURAL GAS

- A. Provide real-time monitoring of whole building natural gas consumption by using a signal from the building utility meter to provide the data input to the BAS. The BAS must be capable of trending gas consumption. Data is to be collected in 15 minute intervals. Storage of at least 3 months of 15 minute data is required on the BAS. Data older than 3 months is to be automatically saved and archived on the BAS computer without being overwritten. Data older than 5 years can be overwritten. It is the responsibility of the mechanical contractor to coordinate this work.

3.04 DOMESTIC HOT WATER

- A. Provide real-time monitoring of the domestic hot water (DHW) system by measuring water flow to DHW heater and DHW supply and return temperatures and providing data input to the BAS. The BAS must be capable of trending. Data is to be collected in 15 minute intervals. Storage of at least 3 months of 15 minute data is required on the BAS. Data older than 3 months is to be automatically saved and archived on the BAS computer without being overwritten. Data older than 5 years can be overwritten. It is the responsibility of the mechanical contractor to coordinate this work.

3.05 HEATING HOT WATER

- A. Provide real-time monitoring of the heating hot water (HW) system by measuring water flow to the boiler(s) and HW supply and return temperatures and providing data input to the BAS. The BAS must be capable of trending. Data is to be collected in 15 minute intervals. Storage of at least 3 months of 15 minute data is required on the BAS. Data older than 3 months is to be automatically saved and archived on the BAS computer without being overwritten. Data older than 5 years can be overwritten. It is the responsibility of the mechanical contractor to coordinate this work.

3.06 CHILLED WATER

- A. Provide real-time monitoring of the chilled water (CW) system by measuring water flow to the chillers(s) and CW supply and return temperatures and providing data input to the BAS. The BAS must be capable of trending. Data is to be collected in 15 minute intervals. Storage of at least 3 months of 15 minute data is required on the BAS. Data older than 3 months is to be automatically saved and archived on the BAS computer without being overwritten. Data older than 5 years can be overwritten. It is the responsibility of the mechanical contractor to coordinate this work.

3.07 TEMPORARY MONITORING

- A. Provide easy access to allow for the temporary installation of split-core current sensors and voltage sensors for the electrical measurement and datalogging on the following systems:
1. Lighting.
 2. Plug loads.
 3. HVAC equipment including chillers, fans, circulation pumps, and air handling units.
 4. DHW equipment.
- B. Temporary monitoring equipment will be provided by the Cx Agent.

3.08 DDC TRENDS

- A. The Controls Contractor is to provide provision for remote access to BAS to view status of building and the ability to download trendable points per the MbCx requirements in the Cx Plan.

END OF SECTION

**SECTION 02 41 00
DEMOLITION****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Building demolition including Universal waste contamination.
 - 1. Hazardous materials have been removed under prior separate contract.
- B. Selective demolition of built site elements.
- C. Abandonment and removal of existing utilities and utility structures.

1.02 RELATED REQUIREMENTS

- A. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- B. Section 01 57 13 - Temporary Erosion and Sediment Control.
- C. Section 01 60 00 - Product Requirements: Handling and storage of items removed for salvage and relocation.
- D. Section 01 77 00-Closeout Procedures: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.
- E. Section 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- F. Section 02 41 16 - Structural Demolition: Additional City of Madison requirements.
- G. Section 31 10 00 - Site Clearing: Vegetation and existing debris removal; earth stripping and stockpiling.
- H. Section 31 22 00 - Grading: Rough and fine grading.
- I. Section 31 23 23 - Fill: Filling holes, pits, and excavations generated as a result of removal operations.
- J. Section 32 93 00 - Plants: Relocation of existing trees, shrubs, and other plants.
- K. Section 32 93 00 - Plants: Pruning of existing trees to remain.

1.03 DEFINITIONS

- A. Hazardous Materials: Includes regulated asbestos containing materials, lead, PCBs and mercury.
 - B. Universal Waste Contamination: as defined by United States Environmental Protection Agency (EPA) - <https://www.epa.gov/hw/universal-waste#types>
 - 1. Batteries
 - 2. Pesticides
 - 3. Mercury-Containing Equipment
 - 4. Lamps
 - 5. Aerosol Cans
 - C. Demolition: Dismantle, raze, destroy or wreck any building or structure or any part thereof.
 - D. Remove: Detach or dismantle items from existing construction and dispose of them off site, unless items are indicated to be salvaged or reinstalled.
 - E. Remove and Salvage: Detach or dismantle items from existing construction in a manner to prevent damage. Clean, package, label and deliver salvaged items to Owner in ready-for-reuse condition.
 - F. Remove and Reinstall: Detach or dismantle items from existing construction in a manner to prevent damage. Clean and prepare for reuse and reinstall where indicated.
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- G. Existing to Remain: Designation for existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.04 REFERENCE STANDARDS

- A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Site Plan: Indicate:
 - 1. Vegetation to be protected.
 - 2. Areas for temporary construction and field offices.
 - 3. Areas for temporary and permanent placement of removed materials.
- C. Demolition Plan: Submit demolition plan as required by OSHA and local AHJs.
 - 1. Indicate extent of demolition, removal sequencing, bracing and shoring, and location and construction of barricades and fences.
 - 2. Summary of safety procedures.
 - 3. Demolition firm qualifications.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.06 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Company specializing in the type of work required.
 - 1. Minimum of 5 years of documented experience.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Fill Material: See Section 31 23 23.

PART 3 EXECUTION

3.01 DEMOLITION

- A. Hazardous materials have been removed under prior separate contract.
 - 1. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
- B. Remove the entire building as indicated on the drawings.
- C. Remove paving and curbs required to accomplish new work.
- D. Remove all other paving and curbs as indicated on drawings.
- E. Within area of new construction, remove foundation walls and footings to minimum 8 feet (2400 mm) below finished grade.
- F. Outside area of new construction, remove foundation walls and footings to minimum 2 feet (600 mm) below finished grade.
- G. Remove concrete slabs on grade as indicated on drawings.
- H. Remove manholes and manhole covers, curb inlets and catch basins.
- I. Remove fences and gates.
- J. Remove creosote-treated wood utility poles.
- K. Remove other items indicated, for salvage, relocation, and recycling.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with requirements in Section 01 77 00 - Closeout Procedures.
- B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Comply with applicable requirements of NFPA 241.
 - 3. Use of explosives is not permitted.
 - 4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - 5. Provide, erect, and maintain temporary barriers and security devices.
 - 6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 - 7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 8. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
 - 9. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
 - 10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.
- C. Do not begin removal until receipt of notification to proceed from Owner.
- D. Do not begin removal until built elements to be salvaged or relocated have been removed.
- E. Do not begin removal until vegetation to be relocated has been removed and vegetation to remain has been protected from damage.
- F. Protect existing structures and other elements to remain in place and not removed.
 - 1. Provide bracing and shoring.
 - 2. Prevent movement or settlement of adjacent structures.
 - 3. Stop work immediately if adjacent structures appear to be in danger.
- G. Minimize production of dust due to demolition operations. Do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- H. Hazardous Materials:
 - 1. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCBs, and mercury.
 - a. Hazardous materials have been removed under prior separate contract.
- I. Perform demolition in a manner that maximizes salvage and recycling of materials.
 - 1. Comply with requirements of Section 01 74 19 - Construction Waste Management and Disposal.
 - 2. Dismantle existing construction and separate materials.
 - 3. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.
- J. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

3.03 EXISTING UTILITIES

- A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.

- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone. Identify and mark, in same manner as other utilities to remain, utilities to be reconnected.

3.04 DEBRIS AND WASTE REMOVAL

- A. Removal and legal disposal of all demolition materials and all tipping fees is to be paid by the demolition contractor.
- B. Remove debris, junk, and trash from site.
- C. Remove materials not to be reused on site; comply with requirements of Section 01 74 19 - Waste Management.
- D. Leave site in clean condition, ready for subsequent work.
- E. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 02 41 16 STRUCTURAL DEMOLITION

PART 1 – GENERAL

1.01 SCOPE

- A. Structural demolition of the existing building leaving all site improvements and existing building slab and foundations.
- B. Pollution Control during building demolition, including noise control.
- C. Removal and legal disposal of all demolition materials and all tipping fees paid by the demolition contractor.

1.02 RELATED REQUIREMENTS

- A. Section 01 26 57 – Change Order Requests
- B. Section 01 31 19 – Project Meetings
- C. Section 01 31 23 – Project Management Web Site
- D. Section 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling
- E. Section 01 76 00 – Protecting Installed Construction
- F. Section 02 41 00 - Demolition: Standard demolition requirements and processes.
- G. Reuse & Recycling Plan prepared by WasteCap

1.03 REFERENCE STANDARDS

- A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2009.

1.04 SUBMITTALS

- A. Schedule: Submit for approval the structural demolition schedule.
- B. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.05 PRE-INSTALLATION MEETINGS

- A. Convene a minimum two weeks prior to starting any structural demolition.

1.06 SEQUENCING

- A. Immediate areas of work will not be occupied during structural demolition.
- B. No responsibility for buildings and structures to be demolished will be assumed by the owner.

1.07 QUALITY ASSURANCE

- A. Codes and Regulations: Comply with all governing codes and regulations. Use experienced workers.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. REPAIR MATERIALS
 - 1. This will apply to all existing site improvements that are scheduled to remain.
 - 2. Use repair materials identical to existing materials.
 - a. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - b. Use materials whose installed performance equal or surpasses that of existing materials.

PART 3 - EXECUTION**3.01 STRUCTURAL DEMOLITION**

- A. This contract is for the structural demolition of the existing park pavilion shelter located at 1818 Parkside Drive, Reindahl Park, Madison, WI. This contract includes the removal of the structure, shell, concrete slab and foundations and footings. The contractor shall leave the site clean and safe at the completion of the contract.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS**A. STRUCTURAL DEMOLITION**

1. Demolition Operations: Do not damage improvements indicated to remain. Items of salvage value will be removed from the building per the WasteCap Reuse & Recycling Plan. Storage or sale of items at the project site is prohibited.
2. Remove other items indicated in the WasteCap Reuse & Recycling Plan from the premises per the Reuse & Recycling Plan.
3. All other materials from the demolition of the existing structure are to be properly disposed of offsite by the contractor including removal of abandoned utilities and wiring systems.
4. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
5. Obtain required permits.
6. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
7. Provide, erect, and maintain temporary barriers and security devices.
8. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
9. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
10. Do not close or obstruct roadways or sidewalks without permit.
11. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
12. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
13. Protect existing structures and other elements that are not to be removed.
14. Cease operations if public safety or remaining structures are endangered. Perform temporary corrective measures until operations can be continued properly.
15. Stop work immediately if adjacent structures appear to be in danger.
16. Provide adequate protection against accidental trespassing. Secure project after working hours.
17. Restore finishes of any areas damaged during demolition that were noted to remain.
 - a. All existing site improvements and building ground floor slab are to remain.
18. Hazardous materials have been removed under prior separate contract. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
19. Perform demolition in a manner that maximizes salvage and recycling of materials.
20. Comply with requirements of Section 01 74 19 - Waste Management.
21. Dismantle existing construction and separate materials.
22. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

3.03 EXISTING UTILITIES

- A. Protect existing utilities to remain from damage.
- B. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
-

- C. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- D. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- E. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as shown.
 - 2. Report discrepancies to City Construction Manager before disturbing existing installation.
 - 3. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.
 - 4. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
 - 5. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- B. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items indicated on drawings.
- C. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - 3. Verify that abandoned services serve only abandoned facilities before removal.
 - 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- D. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch as specified for patching new work.

3.05 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Remove debris, junk, and trash from site.
- B. Remove from site all materials not to be reused on site; comply with requirements of Section 01 74 19 – Waste Management.
- C. Leave site in clean condition, ready for subsequent work.
- D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

**SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Openings for other work.
- B. Form accessories.
- C. Form stripping.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 04 20 00 - Unit Masonry: Reinforcement for masonry.
- C. Section 05 12 00 - Structural Steel Framing: Placement of embedded steel anchors and plates in cast-in-place concrete.
- D. Section 05 21 00 - Steel Joist Framing: Placement of embedded steel anchors, plates and joist seats in cast-in-place concrete.
- E. Section 05 31 00 - Steel Decking: Placement of steel anchors in composite decking.
- F. Section 31 23 16 - Excavation: Shoring and underpinning for excavation.

1.03 REFERENCE STANDARDS

- A. ACI 117 - Specification for Tolerances for Concrete Construction and Materials 2010 (Reapproved 2015).
- B. ACI 301 - Specifications for Concrete Construction 2020.
- C. ACI 347R - Guide to Formwork for Concrete 2014 (Reapproved 2021).
- D. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices 2022.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2023.
- F. PS 1 - Structural Plywood 2019.

PART 2 PRODUCTS

2.01 FORMWORK - GENERAL

- A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.
- B. Design and construct concrete that complies with design with respect to shape, lines, and dimensions.
- C. Chamfer outside corners of beams, joists, columns, and walls.
- D. Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.

2.02 WOOD FORM MATERIALS

- A. Plywood: Douglas Fir species; solid one side grade; sound undamaged sheets with clean, true edges.
- B. Douglas Fir or Spruce species; construction grade or better; with grade stamp clearly visible.

2.03 REMOVABLE PREFABRICATED FORMS

- A. Preformed Steel Forms: Minimum 16 gauge, 0.0598 inch thick, matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

- B. Preformed Plastic Forms: Thermoplastic polystyrene form liner, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- C. Tubular Column Type: Round, spirally wound laminated fiber material, surface treated with release agent, non-reusable, of sizes indicated.
- D. Void Forms: Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete mix until initial set; 2 inches thick.
- E. Contractor shall use formwork, form components and accessories provided by a single manufacturer. Intermitting of formwork, components and accessories shall not be allowed.

2.04 FORMWORK ACCESSORIES

- A. Form Ties: Removable type, galvanized metal, fixed length, cone type, with waterproofing washer; a 1-inch back break dimension, free of defects that could leave holes larger than 1-inch in concrete surface.
 - 1. Manufacturers:
 - a. Advance Concrete Formwork, Inc.
 - b. Dayton Superior.
 - c. Symons - A Dayton Superior Company.
 - d. Williams Form Engineering Corporation.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.
 - 1. Composition: Colorless, reactive, water-based or solvent-based compound.
 - 2. Products:
 - a. W. R. Meadows, Inc; Duogard: www.wrmeadows.com/#sle.
 - b. Dayton Superior.
 - c. Williams Form Engineering Corporation.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Dovetail Anchor Slot: Galvanized steel, at least 22 gauge, 0.0299 inch thick, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
 - 1. Products:
 - a. Dur-O-Wal, Inc.; DA100.
 - b. Heckman Building Products, Inc.; #100.
 - c. Homann & Barnard; #305.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Flashing Reglets: Galvanized steel, at least 22 gauge, 0.0299 inch thick, longest possible lengths, with alignment splines for joints, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
 - 1. Products:
 - a. Fry Reglet Company.; "CO" Concrete Reglet.
 - b. Heckman Building Products, Inc.; #231 Stay Put Reglet.
 - c. Homann & Barnard; CR Concrete Reglet.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Embedded Anchor Shapes, Plates, Angles and Bars: As specified in Section 05 12 00.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.02 EARTH FORMS

- A. Earth forms are not permitted.

3.03 ERECTION - FORMWORK

- A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.
- C. Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.

3.04 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

3.05 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for items to be embedded in passing through concrete work.
- B. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.

3.06 FORMWORK TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 117, unless otherwise indicated.

3.07 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

END OF SECTION

**SECTION 03 30 00
CAST-IN-PLACE CONCRETE**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete shoring, bracing, and anchorage.
- B. Floors and slabs on grade.
- C. Concrete reinforcement and accessories.
- D. Miscellaneous concrete elements, including equipment pads, equipment pits, light pole bases, flagpole bases, thrust blocks, and manholes.
- E. Concrete curing.
- F. Admixtures.

1.02 RELATED REQUIREMENTS

- A. Section 03 10 00 - Concrete Forming and Accessories: Forms and accessories for formwork.
- B. Section 03 36 16 - Reactive Chemical Concrete Stain.
- C. Division 07 - Thermal and Moisture Protection: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.
- D. Division 07 - Finishes: Concrete slab moisture and alkalinity testing and remediation procedures.

1.03 REFERENCE STANDARDS

- A. ACI 117 - Specification for Tolerances for Concrete Construction and Materials 2010 (Reapproved 2015).
 - B. ACI 211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide 2022.
 - C. ACI 301 - Specifications for Concrete Construction 2020.
 - D. ACI 302.1R - Guide to Concrete Floor and Slab Construction 2015.
 - E. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete 2000 (Reapproved 2009).
 - F. ACI 305R - Guide to Hot Weather Concreting 2020.
 - G. ACI 306R - Guide to Cold Weather Concreting 2016.
 - H. ACI 308R - Guide to External Curing of Concrete 2016.
 - I. ACI 318 - Building Code Requirements for Structural Concrete 2019 (Reapproved 2022).
 - J. ACI 347R - Guide to Formwork for Concrete 2014 (Reapproved 2021).
 - K. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2022.
 - L. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars 2022.
 - M. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete 2022.
 - N. ASTM C33/C33M - Standard Specification for Concrete Aggregates 2023.
 - O. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens 2021.
 - P. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete 2023.
 - Q. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens) 2021.
 - R. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete 2020.
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- S. ASTM C150/C150M - Standard Specification for Portland Cement 2022.
- T. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete 2020.
- U. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete 2010a (Reapproved 2016).
- V. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete 2019.
- W. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete 2019, with Editorial Revision (2022).
- X. ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete 2023, with Editorial Revision.
- Y. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete 2021.
- Z. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink) 2020.
- AA. ASTM C1116/C1116M - Standard Specification for Fiber-Reinforced Concrete 2023.
- BB. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures 2020.
- CC. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete 2018.
- DD. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types) 2018.
- EE. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting 2023.
- FF. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars 2021.
- GG. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a, with Editorial Revision (2023).
- HH. ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers 2020.
- II. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs 2018a.
- JJ. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs 2017 (Reapproved 2023).

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Submit shop drawings of reinforcing steel under provisions of Division 01 – General Requirements.
 - 1. Initial submittal of reinforcement shop drawings shall be complete. No partial submittals will be accepted.
 - 2. Indicate reinforcement sizes, spacings, locations and quantities of reinforcing steel, and wire reinforcement, bending and cutting schedules, splicing, supporting and spacing devices.
 - 3. Reinforcement placement shop drawings for foundations and walls shall conform to ACI SP-66 providing full wall elevations.
- C. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements: Aggregates.
- E. Mix Design: Submit proposed concrete mix design.

1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.
 2. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.
 3. Indicate proposed mix design complies with fiber reinforcing manufacturer's written recommendations.
- F. Samples: Submit samples of underslab vapor retarder to be used.
- G. Test Reports: Submit report for each test or series of tests specified.
- H. Cement Replacement Design Reporting: If any fly ash, ground granulated blast furnace slag, silica fume, rice hull ash, or other waste material is used in mix designs to replace Portland cement, submit the total volume of concrete cast in place, mix design(s) used showing the quantity of portland cement replaced, reports showing successful cylinder testing, and temperature on day of pour if cold weather mix is used.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301 and ACI 318.
1. Maintain one copy of each document on site.
- B. Follow recommendations of ACI 305R when concreting during hot weather.
1. Placement and curing of concrete subject to a combination of (1) rising air temperature (generally greater than 75 degrees F) and (2) wind and low relative humidity shall be in accordance with ACI 305R.
 2. Contractor shall provide plan for minimizing exposure of concrete to adverse conditions due to combinations of high air temperature, direct sunlight, drying winds, and high concrete temperature.
 3. Protect concrete from rapid temperature drop.
 4. Pre-wet subgrade and forms.
- C. Follow recommendations of ACI 306R when concreting during cold weather.
1. Placement and curing of concrete where (1) average daily temperature for three consecutive days is less than 40 degrees F, and (2) air temperature is not greater than 50 degrees F for more than one-half of a 24-hour period from midnight to midnight shall be in accordance with ACI 306.1.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

1.06 SLAB PRE-CONSTRUCTION MEETING

- A. At least 20 days prior to placing first concrete floor slab, Contractor shall hold a meeting to review detailed requirements for preparing final concrete design mixes and to establish procedures for placing, finishing, curing, and protecting concrete to meet required quality under anticipated conditions.
- B. Contractor shall request responsible representatives of each party concerned with concrete work to attend a meeting, including but not limited to the following:
1. Contractor's Superintendent.
 2. Structural Engineer.
 3. Testing Laboratory responsible for field quality control.
 4. Concrete Subcontractor's Project Manager.
 5. Ready-mix Concrete Supplier.
 6. Architect.
- C. Minutes of the meeting shall be recorded, typed, reproduced and distributed by Contractor to all parties concerned within five working days of meeting.

- D. Minutes shall include a statement by admixture manufacturer(s) indicating that proposed mix design and placing can produce concrete quality required by this Section.
- E. Contractor shall notify Structural Engineer and Architect at least 10 days prior to scheduled date of meeting.

PART 2 PRODUCTS

2.01 FORMWORK

- A. Comply with requirements of Section 03 10 00.

2.02 REINFORCEMENT MATERIALS

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
 - 1. Type: Deformed billet-steel bars.
 - 2. Finish: Unfinished, unless otherwise indicated.
 - 3. Finish: Epoxy coated in accordance with ASTM A775/A775M, unless otherwise indicated.
 - 4. Reinforcing bars to be welded shall conform to ASTM A706.
- B. Steel Welded Wire Reinforcement (WWR): Plain type, ASTM A1064/A1064M.
- C. Reinforcement Accessories:
 - 1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch.
 - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete.
 - 3. Provide stainless steel, galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches of weathering surfaces.

2.03 CONCRETE MATERIALS

- A. Cement: ASTM C150/C150M, Type I - Normal Portland type.
- B. Fine and Coarse Aggregates: ASTM C33/C33M.
- C. Fly Ash: ASTM C618, Class C or F.
- D. Calcined Pozzolan: ASTM C618, Class N.
- E. Silica Fume: ASTM C1240, proportioned in accordance with ACI 211.1.
- F. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.
- G. Structural Fiber Reinforcement: ASTM C1116/C1116M, Type III.
 - 1. Fiber Type: Alkali-resistant synthetic macro fibers.
 - 2. Products:
 - a. Euclid Chemical Company; TUF-STRAND SF: www.euclidchemical.com
 - b. Forta Corporation; FORTA-FERRO (2-1/4"): www.forta-ferro.com
 - c. GCP Applied Technologies; STRUX 90/40: www.gcpat.com
 - d. Propex Concrete Systems Corporation - Fibermesh 650; www.fibermesh.com
 - e. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 ADMIXTURES

- A. Chemical Admixture: ASTM C494
- B. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- C. Admixtures shall be used in accordance with manufacturer's written recommendations.
- D. Admixtures containing chlorides, sulfides, or nitrides are not permitted.
- E. Admixtures permitted shall be supplied by a single manufacturer for project.

- F. Air Entrainment Admixture: ASTM C260/C260M.
 - 1. Manufacturers:
 - a. BASF Admixtures, Inc.
 - b. Grace Construction Products.
 - c. The Euclid Chemical Company.
 - d. Substitutions: As approved by Engineer/Architect.
- G. Water Reducing Admixture: ASTM C494/C494M Type A.

2.05 ACCESSORY MATERIALS

- A. Underslab Vapor Retarder:
 - 1. Sheet Material: ASTM E1745, Class A 15-mm (6-mil) thickness; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. Single-ply polyethylene is prohibited.
 - 2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
 - 3. Products:
 - a. Henry Company; Moistop Ultra 15: www.henry.com
 - b. Stego Industries, LLC; Stego Wrap Vapor Barrier - 15 milsd: www.stegoindustries.com
 - c. W. R. Meadows, Inc; PERMINATOR Class A - 15 mils (0.25 mm): www.wrmeadows.com
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 - 1. Grout: Comply with ASTM C1107/C1107M.
 - 2. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
 - 3. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.
- C. Non-Shrink Epoxy Grout: Moisture-insensitive, two-part; consisting of epoxy resin, non-metallic aggregate, and activator.
- D. Non-Slip Aggregate:
 - 1. Manufacturers:
 - a. Anti-Hydro - A-H Emery.
 - b. BASF Building Systems, Inc. - Frictex NS.
 - c. Dayton Superior - Emery Non-Slip.
 - d. The Euclid Chemical Company - Non-Slip Aggregate.
 - e. Substitutions: As approved by Engineer.

2.06 BONDING AND JOINTING PRODUCTS

- A. Reglets: Formed steel sheet, galvanized, with temporary filler to prevent concrete intrusion during placement.
 - 1. Size: 1/2 inch throat, 1/2 inch deep.
 - 2. Manufacturers:
 - a. Fry Reglet Company – "CO" Concrete Reglet.
 - b. Heckman Building Products, Inc. - #231 Stay Put Reglet.
 - c. Hohmann & Barnard - CR - Concrete Reglet.
 - d. Substitutions: As approved by Engineer.
- B. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.
 - 1. Material: ASTM D1751, cellulose fiber.
 - 2. Products:
 - a. Nomaco, Inc; Nomaflex Expansion Joint Filler with Void Cap Option: www.nomaco.com
 - b. W. R. Meadows, Inc; Fiber Expansion Joint Filler with Snap-Cap: www.wrmeadows.com

- c. Substitutions: See Section 01 60 00 - Product Requirements.

2.07 CURING MATERIALS

- A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.
1. Products:
 - a. Dayton Superior Corporation; Aquafilm J74: www.daytonsuperior.com
 - b. Euclid Chemical Company ; EUCOBAR: www.euclidchemical.com
 - c. W. R. Meadows, Inc ; Evapre or Evapre-RTU: www.wrmeadows.com
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309.
1. Products:
 - a. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W): www.daytonsuperior.com
 - b. Euclid Chemical Company; COLOR-CRETE CURE AND SEAL VOC: www.euclidchemical.com
 - c. W. R. Meadows, Inc; 1100-Clear: www.wrmeadows.com/#sle.
- C. Resin Curing Compound: Solvent-based liquid, white pigmented, membrane-forming.
1. For use on exterior slabs. When slab will be painted, sealed, topped, or receive other applied finish, completely remove curing compound after curing is complete and before finish coatings are applied.
 2. Comply with ASTM C309, Type 2, Classes A and B.
 3. Products:
 - a. Dayton Superior Corporation; Dayton Superior - Day-Chem City White Cure (J-8): www.daytonsuperior.com
 - b. Euclid Chemical Company; KUREZ VOX WHITE PIGMENTED: www.euclidchemical.com
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Curing Compound, Non-dissipating: Liquid, membrane-forming, clear, non-yellowing acrylic; complying with ASTM C309.
1. Products:
 - a. Dayton Superior Corporation; Safe Cure & Seal (J-18): www.daytonsuperior.com
 - b. W. R. Meadows, Inc; VOCOMP-20: www.wrmeadows.com
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Liquid Hardener and Densifiers:
1. Manufacturers:
 - a. BASF Building Systems, Inc. - Sonneborn Kure-N-Harden.
 - b. Dayton Superior - Day-Chem Sure Hard (J-17).
 - c. The Euclid Chemical Company - Euco Diamond Hard.
 - d. W.R. Meadows - Liqui-Hard.
 - e. Substitutions: As approved by Engineer.
- F. Hardeners and sealer used shall be of same manufacturer.
- G. Curing Paper: ASTM C171;
1. Manufacturers:
 - a. Fortifiber - Orange Label Sisalkraft 280.
 - b. Substitutions: As approved by Engineer.
- H. Burlap shall be clean, evenly woven, free of encrusted concrete or other contaminating materials, and shall be reasonably free of cuts, tears, broken or missing areas.
- I. Polyethylene Film: ASTM D2103, 4 mil, 0.004 inch thick, clear.

- J. Water: Potable, not detrimental to concrete.

2.08 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
1. Replace as much Portland cement as possible with fly ash, ground granulated blast furnace slag, silica fume, or rice hull ash as is consistent with ACI recommendations.
- B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
- C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.
- D. Fiber Reinforcement: Add to mix at rate of 4.0 pounds per cubic yard, or as recommended by manufacturer for specific project conditions.

2.09 SCHEDULE OF MIXES

- A. Footings: Proportion normal-weight concrete mix as follows:
1. Compressive Strength (28 Days): 3000 psi.
 2. Maximum Aggregate Size: 1-1/2 inches.
 3. Maximum Water-Cement Ratio: 0.50.
- B. Foundation Walls: Proportion normal-weight concrete mix as follows:
1. Compressive Strength (28 Days): 4000 psi.
 2. Maximum Aggregate Size: 3/4 - inch.
 3. Air Entrainment: 6 percent air content is required with an acceptable air content of plus or minus 1.5 percent.
- C. Piers: Proportion normal-weight concrete mix as follows:
1. Compressive Strength (28 Days): 4000 psi.
 2. Maximum Aggregate Size: 3/4 - inch.
- D. Interior Slab-on-Ground, Equipment Pads: Proportion normal-weight concrete mix as follows:
1. Compressive Strength (28 Days): 4000 psi.
 2. Maximum Aggregate Size: 1 1/2 - inch.

2.10 MIXING

- A. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

- A. Verify that forms are clean and free of rust before applying release agent.
- B. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- C. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Comply with ASTM E1643. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.
1. Granular Fill Over Vapor Retarder: Cover vapor retarder with compactible granular fill as indicated on drawings. Do not use sand.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

- A. Fabricate and handle epoxy-coated reinforcing in accordance with ASTM D3963/D3963M.
- B. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.
- C. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.
- D. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.
- E. Locate reinforcing splices as shown on Drawings.
- F. Cut ends of epoxy coated rebars shall be coated with epoxy material equivalent to factory coating.
- G. Damage to rebar coating as a result of bending shall be repaired with equivalent coating.

3.04 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Place concrete for floor slabs in accordance with ACI 302.1R.
- C. Place pumped concrete in accordance with ACI 304.2R. Line coating mix to initiate pumping shall not be used in pour but shall be wasted.
- D. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- E. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.
- F. Concrete with excessive honeycomb or embedded debris shall be rejected and replaced at no cost to Owner.
- G. Application of surface retarders and sawcutting of joints shall be planned in advance.
- H. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures and mechanical injury.
- I. Placing During Hot Weather:
 - 1. Place concrete during hot weather conditions in accordance with ACI 305R.
- J. Placing During Cold Weather:
 - 1. Place concrete during cold weather conditions in accordance with ACI 306.1.
- K. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

3.05 SLAB JOINTING

- A. Locate joints as indicated on drawings.
- B. Anchor joint fillers and devices to prevent movement during concrete placement.
- C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
 - 1. Install wherever necessary to separate slab from other building members, including columns, walls, equipment foundations, footings, stairs, manholes, sumps, and drains.
- D. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.

3.06 FLOOR FLATNESS AND LEVELNESS TOLERANCES

- A. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values:

1. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values are to be confirmed and provided as specified by floor covering manufacturer.
- B. Measure F(F) Floor Flatness and F(L) Floor Levelness in accordance with ASTM E1155 (ASTM E1155M), within 48 hours after slab installation; report both composite overall values and local values for each measured section.
- C. Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than F(F) 13/F(L) 10.
- D. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.07 CONCRETE FINISHING

- A. Repair surface defects, including tie holes, immediately after removing formwork.
- B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.
- C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
 1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.
- D. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
 1. Other Surfaces to Be Left Exposed: Trowel as described in ACI 302.1R, minimizing burnish marks and other appearance defects.
- E. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:50 nominal or as indicated on drawings.
- F. Where a schedule of finishes is not included in this Section, or finishes are not shown on Drawings, the following finishes shall be used as applicable: Rough Form Finish for all concrete surfaces not exposed to public view; Smooth Form Finish with Smooth Rubbed Finish for all concrete surfaces exposed to public view.

3.08 CURING AND PROTECTION

- A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
 1. Normal concrete: Not less than seven days.
- C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.
- D. Surfaces Not in Contact with Forms:
 1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.
 2. Due to latent residual moisture issues, wet curing is not an acceptable method when a under slab vapor barrier is present and adhesive flooring will be installed.
 3. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
 - a. Ponding: Maintain 100 percent coverage of water over floor slab areas, continuously for 4 days.
 - b. Spraying: Spray water over floor slab areas and maintain wet.
 - c. Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.
 4. Final Curing: Begin after initial curing but before surface is dry.

- a. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.
5. Apply a liquid hardener and sealer with a damp or moist cure where no floor covering material is specified and floor is subject to moderate traffic and composition or rubber wheels.
6. Apply a non-slip aggregate to stair treads and landings, and ramps not scheduled to receive floor covering, in accordance with manufacturer's instructions, trowel to a hard finish, and treat surface with liquid hardener without sealer.

3.09 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 45 16-Field Quality Control Procedures for City of Madison requirements.
- B. Provide free access to concrete operations at project site and cooperate with appointed firm.
- C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
- D. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.
- E. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards or less of each class of concrete placed.
- F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
- G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.10 DEFECTIVE CONCRETE

- A. Test Results: The testing agency shall report test results in writing to Architect, Engineer, and Contractor within 24 hours of test.
- B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.
- C. Repair or replacement of defective concrete will be determined by the Architect and Engineer. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
- D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect and Engineer for each individual area.

3.11 PROTECTION

- A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION

SECTION 03 36 16
REACTIVE CHEMICAL CONCRETE STAIN

PART 1 GENERAL

1.01 SUMMARY

Section includes:

- A. Chemically stained concrete floor finish.
- B. Sealer.

1.02 RELATED SECTIONS:

- A. Section 03 30 00 - Cast-In-Place Concrete: for general concrete applications.
- B. Section 07 92 00 - Joint Sealants: for colored sealant installed in paving joints.
- C. Section 09 05 61 – Common Work Results for Flooring Preparation.

1.03 REFERENCES

- A. ASTM C 171: Standard Specification for Sheet Materials for Curing Concrete.
- B. ASTM C 309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- C. ASTM F 1869: Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

1.04 SUBMITTALS

- A. Product Data: Manufacturer's technical data, including Safety Data Sheet (SDS) and installation instructions, for each product specified.
- B. LEED Documentation:
 - 1. Low-Emitting Materials - Paints & Coatings: Verification of VOC content.
- C. Samples for Initial Selection: Manufacturer's color charts showing selected color.
- D. Qualification Data: For Manufacturer and Installer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 10 years of documented experience producing the specified products.
- B. Installer Qualifications: Minimum 5 years of documented experience with work of similar scope and complexity required by this Project and acceptable to, or certified by, concrete stain manufacturer.

1.06 REGULATORY REQUIREMENTS:

- A. Code of Federal Regulations 40 CFR 59, Subpart D and EPA Test Method 24 establish VOC emissions standards and test protocols for architectural coatings.
- B. Products to comply with United States Clean Air Act for maximum Volatile Organic compound (VOC) content as specified in this Section.
- C. Material Source: Obtain each specified material from the same source.
- D. Notification: Give a minimum seven (7) calendar days' notice to manufacturer's authorized field representative before date established for commencement of concrete stain work.

1.07 CONCRETE STAIN MOCKUPS:

- A. Construct a 10 foot by 10 foot mockup at location selected by Architect.
- B. Provide individual mockups for each color and pattern required.
- C. Construct mockup using materials, processes, and techniques required for the work, including curing procedures. Incorporate representative control, construction, and expansion joints according to Project requirements. Installer for the work to construct mockup.

- D. Mockup to be stained and sealed by the Installer who will actually perform the work for the Project. Record the amount of chemical stain needed per square foot of application to establish coverage rates for the work.
- E. Notify Architect and Owner a minimum of seven (7) calendar days in advance of the date scheduled for each mockup construction.
- F. Obtain the Architect's and Owner's acceptance of each mockup prior to commencement of the work.
- G. Each mockup to remain until completion of the work to serve as a quality control standard for the work. Provide suitable protections to preclude damage to mockup.
- H. Demolish and remove each mockup from site when directed, unless directed to relocate to another area within the project site.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in original factory unopened, undamaged packaging bearing identification of product, manufacturer, batch number, and expiration date as applicable.
- B. Store products in a location protected from damage, construction activity, and adverse environmental conditions, and away from combustible materials and sources of heat, according to manufacturer's printed instructions and current recommendations.
- C. Handle products according to manufacturer's printed instructions.

1.09 PROJECT CONDITIONS

- A. Environmental Conditions: Maintain an ambient temperature between 50 deg F and 90 deg F during application and at least 48 hours after application.

1.10 PREINSTALLATION CONFERENCE

- A. Seven calendar days prior to scheduled date of installation, conduct a meeting at Project site to discuss requirements, including application methods. Attendees to include Architect, Owner, Contractor, Installer, and manufacturer's authorized field representative.

1.11 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Basis of Design: Sika Corporation; www.usa.sika.com.
- B. Substitutions: Permitted
 - 1. All products should be from the same manufacturer.

2.02 MATERIALS

- A. Reactive Chemical Concrete Stain: Reactive, acid-based solution of metallic salts which react with calcium hydroxide in cured concrete substrates to produce permanent variegated or translucent color effects.
 - 1. Product:
 - a. Basis of Design: LITHOCHROME Chemstain Classic
 - b. Color: CS-13 Copper Patina
 - c. Zero VOC content.
- B. Sealers: A colorless clear water based concrete curing compound and abrasion resistant sealer for use on aged or freshly placed interior or exterior concrete surfaces.
 - 1. Product:
 - a. Basis of Design: SCOFIELD Cureseal-W

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Examine areas and conditions under which the concrete stain work will be performed and identify conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.
- B. Interior Applications: Concrete substrates must have a moisture vapor emission rate of less than 5 lbs./1000 sq. ft. per 24 hour based on a 72 hour test period according to ASTM F 1869.

3.02 PREPARATION

- A. New Concrete: Comply with the following:
 - 1. Newly placed concrete to sufficiently cure for concrete to become reactive. Minimum cure time is 14 days.
 - 2. Interior Applications: Minimum cure time of concrete is 30 to 60 days, or longer if necessary to meet the specified water vapor transmission requirements.
 - 3. Do not use liquid curing materials. Cure concrete flatwork with new, unwrinkled, non-staining, high quality curing paper complying with ASTM C 171. Do not overlap curing paper.
 - 4. Immediately prior to chemically staining, thoroughly clean concrete to remove any contaminants deleterious to subsequent chemical stain application. Sweep surfaces, then pressure wash or scrub using a rotary floor machine with a Mal-Grit Brush from the Malish Corporation. Use suitable, non-acidic, high quality commercial detergents to facilitate cleaning. Rinse surfaces after cleaning until rinse water is completely clean. Allow floor to dry completely prior to application of concrete stain.
 - a. Pressure Washing: Use a pressure washer equipped with a fan tip and rated for a minimum pressure capability of 4000 psi.
- B. Surface Preparation for New or Existing Concrete:
 - 1. Concrete surfaces should be completely penetrable before applying the initial application of chemical stain. The surface of the concrete should be lightly mechanically abraded to remove weak cement paste and contaminants. The final surface preparation should approximate a Concrete Surface Profile of 1, (CSP1 as designated by the International Concrete Repair Institute, Alexandria, Virginia). Methods for mechanical abrasion include:
 - a. Pressure Washing: Use a pressure washer equipped with a fan tip and rated for a minimum pressure capability of 4000 psi.
 - b. Scrubbing with a rotary floor machine with a Mal-Grit Brush from the Malish Corporation.
 - c. Light sanding of the surface.
 - 2. Surfaces should be tested to receive stain by spotting with water. Water should immediately darken the substrate and be readily absorbed. If water beads and does not penetrate or only penetrates in some areas, perform additional surface preparation and testing. On denser concrete floors, sand lightly to open up surfaces. Retest and continue surface preparation until water spots immediately darken and uniformly penetrate concrete surfaces.
 - 3. Rinse concrete substrates until rinse water is completely clean.

3.03 CHEMICAL STAIN APPLICATION

- A. General: Comply with chemical stain manufacturer's printed instructions and current recommendations.
 - 1. Do not mix the specified chemical stain with highly alkaline materials. Doing so will result in a dangerous chemical reaction.
- B. Protect surrounding areas, landscaping, and adjacent surfaces from overspray, runoff, and tracking. Divide surfaces into small work sections using walls, joint lines, or other stationary breaks as natural stopping points.

- C. Apply chemical stains at the coverage rate recommended by the manufacturer and use application equipment according to the chemical stain manufacturer's printed instructions. Note the color of the liquid chemical stain will not be the final color produced on the concrete substrate.
- D. Transfer chemical stain to the substrate by brush or spray and immediately scrub into surface. Reaction time depends on wind conditions, temperatures, and humidity levels.
- E. When multiple coats of one or more colors are required, washing and drying between colors is desirable to evaluate the color prior to the next coat.
- F. Rinsing: After the final coat of chemical stain has remained on the surface for a minimum of four hours, neutralize unreacted chemical stain residue and then remove completely prior to sealing. After neutralization, thoroughly rinse the surface with clean water several times to remove soluble salts. While rinsing, lightly abrade the surface using a low-speed floor machine and red pad to remove residue and weakened surface material. Runoff may stain the adjacent areas or harm plants. Collect rinse water by wet vacuuming or absorbing with an inert material.
 - 1. Failure to completely remove all residue prior to sealing the surface will cause appearance defects, adhesion loss or peeling, reduced durability, and possible bonding failure and delamination of sealer.
 - 2. All stain residue, runoff liquid, and rinse water must be collected and disposed of according to applicable Federal regulations and governing authorities having jurisdiction.

3.04 SEALING APPLICATION

- A. Concrete substrate must be completely dry. Test surface for proper pH prior to applying sealer. A pH value of 7 or higher indicates all acid has been neutralized. If the tested pH value is less than 7, repeat neutralization step until the required pH value is achieved.
- B. Conduct a moisture vapor emission test prior to applying any sealer. Refer to the specific sealer's Technical-Data Bulletin for acceptable MVER.
- C. Apply sealer according the sealer manufacturer's printed instructions at a rate of 300 to 500 square feet per gallon per coat. Maintain a wet edge at all times.
- D. Allow sealer to completely dry before applying additional coats.
- E. Apply second coat of sealer at 90 degrees to the direction of the first coat using the same application method and rates.
- F. Seal horizontal joints in areas subject to pedestrian or vehicular traffic.

3.05 PROTECTION

- A. The General Contractor is responsible for using temporary floor protection throughout the project to safeguard the surface quality of concrete slabs before and after application of decorative finishes or installations of other materials.
- B. All concrete floors that will be not be covered by other materials will be protected throughout the project. The concrete slab must be treated as a finished floor at all times during construction.
- C. Temporary Floor Protection will be removed only while finish work to the concrete is being performed and will be replaced after the final finish has cured sufficiently.
- D. Temporary Floor Protection: install following the manufacturer's recommended products and published installation procedures.
- E. **DO NOT APPLY HEAVY DUTY SEAMING TAPE TO BARE OR FINISHED FLOORS OR WALL SURFACES AT ANY TIME. IT WILL PERMANENTLY DAMAGE THE SURFACE.**

3.06 MAINTENANCE

- A. Maintain chemically stained and sealed floors by sweeping. Clean spills when they occur and rinse dirt off with water. Wet-clean heavily soiled areas by mopping or by scrubbing with a rotary floor machine equipped with a scrubbing brush and a suitable, high quality commercial detergent. Maintain interior floors that require polishing by using a compatible, premium-grade, emulsion-type, commercial floor polish, according to manufacturer's printed instructions and safety requirements.

END OF SECTION

SECTION 04 05 11
MASONRY MORTARING AND GROUTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Mortar for masonry.
- B. Grout for masonry.

1.02 RELATED REQUIREMENTS

- A. Section 04 20 00 - Unit Masonry: Installation of mortar and grout.
- B. Section 08 11 13 - Hollow Metal Doors and Frames: Products and execution for grouting steel door frames installed in masonry.
- C. Section 33 05 61 - Concrete Manholes: Installation of mortar and grout.

1.03 REFERENCE STANDARDS

- A. ASTM C1357-98a - Standard Test Methods for Evaluating Masonry Bond Strength; 2021.
- B. ASTM C5 - Standard Specification for Quicklime for Structural Purposes; 2018.
- C. ASTM C91/C91M - Standard Specification for Masonry Cement; 2023.
- D. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2023.
- E. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.
- F. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- G. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.
- H. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.
- I. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2018.
- J. ASTM C476 - Standard Specification for Grout for Masonry; 2023.
- K. ASTM C780 - Standard Test Methods for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2023.
- L. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.
- M. ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry; 2020.
- N. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength; 2022.
- O. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2023a.
- P. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry; 2019a.
- Q. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry; 2020.
- R. ASTM E518/E518M - Standard Test Methods for Flexural Bond Strength of Masonry; 2022.
- S. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Include design mix and indicate whether the Proportion or Property specification of ASTM C270 is to be used. Also include required environmental conditions and admixture limitations.
- C. Samples: Submit two samples of mortar, illustrating mortar color and color range.

- D. Reports: Submit reports on mortar indicating compliance of mortar to property requirements of ASTM C270 and test and evaluation reports per ASTM C780.
- E. Reports: Submit reports on grout indicating compliance of component grout materials to requirements of ASTM C476 and test and evaluation reports to requirements of ASTM C1019.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- G. Manufacturer's Installation Instructions: Submit packaged dry mortar manufacturer's installation instructions.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 530 and 530.1
- B. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
 - 1. Maintain one copy of each document on project site.

1.06 PRECONSTRUCTION TESTING

- A. Testing will be conducted by an independent test agency, in accordance with provisions of Section 01 45 16-Field Quality Control Procedures for City of Madison requirements.
- B. Mortar Mixes: Test mortars prebatched by weight in accordance with ASTM C780 recommendations for preconstruction testing.
 - 1. Test results will be used to establish optimum mortar proportions and establish quality control values for construction testing.
- C. Grout Mixes: Test grout batches in accordance with ASTM C1019 procedures.
 - 1. Test results will be used to establish optimum grout proportions and establish quality control values for construction testing.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.08 FIELD CONDITIONS

- A. Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

PART 2 PRODUCTS

2.01 MORTAR AND GROUT APPLICATIONS

- A. Use only factory premixed packaged dry materials for mortar and grout, with addition of water only at project site.
 - 1. Exception: If a specified mix design is not available in a premixed dry package, provide equivalent mix design using standard non-premixed materials.
- B. Mortar Color: Natural gray unless otherwise indicated.
- C. Mortar Mix Designs: ASTM C270, Property Specification.
 - 1. Masonry below grade and in contact with earth: Type S.
 - 2. Exterior Masonry Veneer: Type N.
 - 3. Exterior Cavity Walls: Type S mortar with Type N pointing mortar.
 - 4. Engineered Masonry: Type M.
 - 5. Exterior Structural Masonry: Type S using Propoprtion specification.
 - 6. Exterior, Non-loadbearing Masonry: Type N.
 - 7. Interior Structural Masonry: Type N using Proportion specification.
 - 8. Interior, Non-loadbearing Masonry: Type O.
- D. Grout Mix Designs:

1. Structural Masonry: 3,000 psi (21 MPa) strength at 28 days; 8-10 inches (200-250 mm) slump; provide premixed type in accordance with ASTM C 94/C 94M.
 - a. Fine grout for spaces with smallest horizontal dimension of 2 inches (50 mm) or less.
 - b. Coarse grout for spaces with smallest horizontal dimension greater than 2 inches (50 mm).
2. Non-Structural Masonry: 3,000 psi (21 MPa) strength at 28 days; 8-10 inches (200-250 mm) slump; provide premixed type in accordance with ASTM C 94/C 94M.
 - a. Fine grout for spaces with smallest horizontal dimension of 2 inches (50 mm) or less.
 - b. Coarse grout for spaces with smallest horizontal dimension greater than 2 inches (50 mm).

2.02 MATERIALS

- A. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
 1. Type: As noted on structural drawings.
 2. Color: Standard gray.
- B. Packaged Dry Material for Grout for Masonry: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.
- C. Hydrated Lime: ASTM C207, Type S.
- D. Quicklime: ASTM C5, non-hydraulic type.
- E. Mortar Aggregate: ASTM C144.
- F. Water: Clean and potable.
- G. Accelerating Admixture: Nonchloride type for use in cold weather.
- H. Moisture-Resistant Admixture: Water repellent compound designed to reduce capillarity.
 1. Product: Sikacrete-950 DP.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- I. Bonding Agent: Latex type.

2.03 MORTAR MIXING

- A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.
- B. Maintain sand uniformly damp immediately before the mixing process.
- C. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio; mix in accordance with manufacturer's instructions, uniform in coloration.
- D. Add admixtures in accordance with manufacturer's instructions; mix uniformly.
- E. Do not use anti-freeze compounds to lower the freezing point of mortar.
- F. If water is lost by evaporation, re-temper only within two hours of mixing.

2.04 GROUT MIXING

- A. Mix grout in accordance with ASTM C94/C94M.
- B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for fine and coarse grout.
- C. Grout for Structural Masonry: 3,000 psi strength at 28 days; 8-11 inches slump; mixed in accordance with ASTM C476.
- D. Grout for Non-Structural Masonry: 3,000 psi strength at 28 days; 8-11 inches slump; mixed in accordance with ASTM C476.
- E. Add admixtures in accordance with manufacturer's instructions; mix uniformly.

- F. Do not use anti-freeze compounds to lower the freezing point of grout.

PART 3 EXECUTION

3.01 PREPARATION

- A. Apply bonding agent to existing concrete surfaces.
- B. Plug clean-out holes for grouted masonry with brick masonry units. Brace masonry to resist wet grout pressure.
- C. Mix grout in accordance with ASTM C94/C94M.
- D. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for fine and course grout.
- E. Add admixtures in accordance with manufacturer's instructions; mix uniformly.

3.02 INSTALLATION

- A. Install mortar and grout to requirements of section(s) in which masonry is specified.
- B. Work grout into masonry cores and cavities to eliminate voids.
- C. Do not displace reinforcement while placing grout.

3.03 GROUTING

- A. Use either high-lift or low-lift grouting techniques, at Contractor's option, subject to other limitations of Contract Documents.
- B. Low-Lift Grouting:
 - 1. Limit height of pours to 48 inches (1200 mm).
 - 2. Limit height of masonry to 48 inches (1200 mm) above each pour.
 - 3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
 - 4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.
- C. High-Lift Grouting:
 - 1. Verify that horizontal and vertical reinforcement is in proper position and adequately secured before beginning pours.
 - 2. Hollow Masonry: Limit lifts to maximum 12 feet (3.65 m) and pours to maximum height of 24 feet (7.3 m).
 - 3. Place grout for spanning elements in single, continuous pour.

3.04 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field tests, in accordance with provisions of Section 01 45 16-Field Quality Control Procedures for City of Madison requirements.
- B. Establishing Mortar Mix: In accordance with ASTM C270.
- C. Test and evaluate mortar in accordance with ASTM C780 procedures.
 - 1. Test with same frequency as specified for masonry units.
- D. Test and evaluate grout in accordance with ASTM C1019 procedures.
 - 1. Test with same frequency as specified for masonry units.
- E. Prism Tests: Test masonry and mortar panels for compressive strength in accordance with ASTM C1314, and for flexural bond strength in accordance with ASTM C1072 or ASTM E518/E518M; perform tests and evaluate results as specified in individual masonry sections.
- F. Test flexural bond strength of mortar and masonry units to ASTM C1357; test in conjunction with masonry unit sections specified.

END OF SECTION

**SECTION 04 20 00
UNIT MASONRY****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Concrete Masonry units.
- B. Mortar and grout.
- C. Reinforcement and anchorage.
- D. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 04 05 11 - Masonry Mortaring and Grouting.
- B. Section 06 10 00 - Rough Carpentry: Nailing strips built into masonry.
- C. Section 07 25 00 - Weather Barriers: Water-resistive barriers applied to exterior face of backing sheathing or unit masonry substrate.
- D. Section 07 84 00 - Firestopping: Firestopping at penetrations of fire-rated masonry and at top of fire-rated walls.
- E. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.

1.03 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ASTM A580/A580M - Standard Specification for Stainless Steel Wire; 2023.
- C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- D. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.
- E. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2022.
- F. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.
- G. ASTM C55 - Standard Specification for Concrete Building Brick; 2022.
- H. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2022.
- I. ASTM C126 - Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units; 2022.
- J. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2022.
- K. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units; 2023.
- L. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- M. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.
- N. ASTM C476 - Standard Specification for Grout for Masonry; 2023.
- O. ASTM C780 - Standard Test Methods for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2023.
- P. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength; 2022.
- Q. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2017 (Reapproved 2023).
- R. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2017.

- S. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls; 2005.
- T. BIA Technical Notes No. 46 - Maintenance of Brick Masonry; 2017.
- U. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata.
- V. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for brickwork support system.
- D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- E. Manufacturer's Qualification Statement.
- F. Installer's Qualification Statement.

1.06 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
 - 1. Maintain one copy of each document on project site.
- B. Fire Rated Assemblies: Comply with applicable code for rated assemblies as shown on architectural drawings.
- C. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum three years of documented experience.
- D. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.07 MOCK-UPS

- A. See Section 01 43 39 - Mockups

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
 - 1. Size: Standard units with nominal face dimensions of 16 by 8 inches (400 by 200 mm) and nominal depth of 8 inches (200 mm).
 - a. Door Jambs and Exposed Edges: provide and install bull-nose corners.
 - 2. Concrete Masonry Compressive Strength (f'm); 2,000 psi; determined net unit strength method.
 - a. Concrete Masonry Units: 2,800 psi minimum net area compressive strength.
 - 3. Load-Bearing Units: ASTM C90, normal weight.
 - a. Hollow block, as indicated.
 - 4. Nonloadbearing Units: ASTM C129.
 - a. Hollow block, as indicated.

2.02 MORTAR AND GROUT MATERIALS

- A. Mortar and Grout: As specified in Section 04 05 11.

2.03 REINFORCEMENT AND ANCHORAGE

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), deformed billet bars; uncoated.
- B. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.
- C. Single Wythe Joint Reinforcement: ASTM A951/A951M.
1. Type: Ladder.
 2. Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3.
 3. Size: 0.1875 inch side rods with 0.1875 inch cross rods; width as required to provide not
- D. Strap Anchors: Bent steel shapes, 1-1/2 inch (38 mm) width, 0.105 inch (2.7 mm) thick, 24 inch (610 mm) length, with 1-1/2 inch (38 mm) long, 90 degree bend at each end to form a U or Z shape or with cross pins, hot dip galvanized to ASTM A153/A153M Class B.
- E. Anchor Rods: ASTM A307; Grade C; J-shaped or L-shaped; complete with washers and heavy hex nuts; sized for minimum 15 inch embedment; galvanized finish.
1. Hot-Dipped Galvanizing: ASTM A153.
 - 2.
- F. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch (16 mm) of mortar coverage from masonry face.
- G. Two-Piece Wall Ties: Formed steel wire, 0.1875 inch (4.8 mm) thick, adjustable, eye and pintle type, hot dip galvanized to ASTM A 153/A 153M, Class B, sized to provide not less than 5/8 inch (16 mm) of mortar coverage from masonry face and to allow vertical adjustment of up to 1-1/4 in (32 mm).
- H. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws; corrosion resistant finish or hot dip galvanized to ASTM A153/A153M.

2.04 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
1. Manufacturers:
 - a. Blok-Lok Limited: www.blok-lok.com/#sle.
 - b. Hohmann & Barnard, Inc: www.h-b.com/#sle.
 - c. WIRE-BOND: www.wirebond.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding; in maximum lengths available.
1. Manufacturers:
 - a. Hohmann & Barnard, Inc: www.h-b.com/#sle.
 - b. WIRE-BOND: www.wirebond.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Building Paper: ASTM D226/D226M, Type I ("No.15") asphalt felt.
- D. Nailing Strips: Softwood lumber, preservative treated; as specified in Section 06 10 00.
- E. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.
-

3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COLD AND HOT WEATHER REQUIREMENTS

- A. Maintain materials and surrounding air temperature to minimum 50 degrees F (10 degrees C) prior to, during, and 48 hours after completion of masonry work.
- B. Maintain materials and surrounding air temperature to maximum 90 degrees F (32 degrees C) prior to, during, and 48 hours after completion of masonry work.

3.04 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
 - 1. Bond: Running.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches (200 mm).
 - 3. Mortar Joints: Concave.

3.05 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- D. Remove excess mortar and mortar smears as work progresses.
- E. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
- F. Interlock intersections and external corners, except for units laid in stack bond.
- G. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- H. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- I. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
- J. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
- K. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.06 REINFORCEMENT AND ANCHORAGE - GENERAL, SINGLE WYTHE MASONRY, AND CAVITY WALL MASONRY

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches (400 mm) on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches (400 mm) each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Embed longitudinal wires of joint reinforcement in mortar joint with at least 5/8 inch (16 mm) mortar cover on each side.
- E. Lap joint reinforcement ends minimum 6 inches (150 mm).

- F. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches (900 mm) horizontally and 24 inches (600 mm) vertically.

3.07 REINFORCEMENT AND ANCHORAGE - EXTERIOR CLADDING

- A. Masonry Back-up:
1. Embed anchors to bond exterior cladding as recommended by the cladding manufacturer.
 2. If Masonry Back-Up requirements are not specified by the cladding manufacturer, then embed anchors to bond veneer at maximum 16 inches (400 mm) on center vertically and 36 inches (900 mm) on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches (200 mm) on center.

3.08 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
1. Extend flashings full width at such interruptions and at least 6 inches (152 mm), minimum, into adjacent masonry or turn up flashing ends at least 1 inch (25.4 mm), minimum, to form watertight pan at nonmasonry construction.
 2. Remove or cover protrusions or sharp edges that could puncture flashings.
 3. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Terminate flashing up 8 inches (203 mm) minimum on vertical surface of backing:
- C. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7.
- D. Extend metal flashings through exterior face of masonry and terminate in an angled drip with hemmed edge. Install joint sealer below drip edge to prevent moisture migration under flashing.
- E. Support flexible flashings across gaps and openings.
- F. Lap end joints of flashings at least 6 inches (152 mm), minimum, and seal watertight with flashing sealant/adhesive.

3.09 GROUTED COMPONENTS

- A. Reinforce bond beams with 2, No. 5 bars, 1 inch (25 mm) from bottom web.
- B. Lap splices minimum 24 bar diameters.
- C. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch (13 mm) of dimensioned position.
- D. Place and consolidate grout fill without displacing reinforcing.
- E. At bearing locations, fill masonry cores with grout for a minimum 12 inches (300 mm) either side of opening.

3.10 CONTROL AND EXPANSION JOINTS

- A. Install control and expansion joints at the following maximum spacings, unless otherwise indicated on Drawings:
1. Exterior Walls: 20 feet on center and within 24 inches on one (1) side of each interior and exterior corner.
 2. Interior Walls: 30 feet on center.
 3. At changes in wall height.
- B. Do not continue horizontal joint reinforcement through control or expansion joints.
- C. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- D. Size control joints as indicated on drawings; if not indicated, 3/4 inch (19 mm) wide and deep.

3.11 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames and glazed frames and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
 - 1. Fill adjacent masonry cores with grout minimum 12 inches (300 mm) from framed openings.
- D. Do not build into masonry construction organic materials that are subject to deterioration.

3.12 TOLERANCES

- A. Install masonry within the site tolerances found in TMS 402/602.
- B. Maximum Variation from Alignment of Columns and Pilasters: 1/4 inch (6 mm).
- C. Maximum Variation From Unit to Adjacent Unit: 1/16 inch (1.6 mm).
- D. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft (6 mm/3 m) and 1/2 inch in 20 ft (13 mm/6 m) or more.
- E. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in two stories or more.
- F. Maximum Variation from Level Coursing: 1/8 inch in 3 ft (3 mm/m) and 1/4 inch in 10 ft (6 mm/3 m); 1/2 inch in 30 ft (13 mm/9 m).
- G. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch (minus 6.4 mm, plus 9.5 mm).
- H. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch (6 mm).

3.13 CUTTING AND FITTING

- A. Cut and fit for chases, pipes, conduit, sleeves, and grounds. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.14 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 45 16-Field Quality Control Procedures for City of Madison requirements.
- B. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140/C140M for compliance with requirements of this specification.
- C. Mortar Tests: Test each type of mortar in accordance with ASTM C780, testing with same frequency as masonry samples.

3.15 CLEANING

- A. Section 01 77 00 – Closeout Requirements: Final cleaning.
- B. Remove excess mortar and mortar droppings.
- C. Replace defective mortar. Match adjacent work.
- D. Clean soiled surfaces with cleaning solution.
- E. Use non-metallic tools in cleaning operations.

3.16 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

- B. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.
- C. Protect base of walls from mud and mortar splatter.
- D. Protect masonry and other items built into masonry walls from mortar droppings and staining caused by mortar.
- E. Protect tops of concrete unit masonry work exposed to weather, with waterproof coverings secured in place without damaging masonry.
- F. Provide coverings where masonry is exposed to weather when work is not in progress.

END OF SECTION

**SECTION 05 12 00
STRUCTURAL STEEL FRAMING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fabrication, transportation, delivery, and erection of structural steel.
- B. Structural steel framing members.
- C. Structural steel support members, suspension cables, sag rods, struts, bracing, purlins, welds, and fasteners.
- D. Base plates, anchor rods, bearing plates, weld plates, anchors, shear stud connectors, and expansion joint plates.
- E. Inserts for steel work.
- F. Non-shrink grouting under base plates.
- G. Cutting, fitting, removal, and revision to existing structural framing and connections in order to fit new work to existing.

1.02 PRODUCTS SUPPLIED BUT NOT INSTALLED UNDER THIS SECTION

- A. Section 03 30 00 – Cast-in-Place Concrete: Non-shrink grout under base plates and anchors for casting into concrete.
- B. Section 04 20 11 – Concrete Unit Masonry: Anchors for embedding into masonry.

1.03 RELATED REQUIREMENTS

- A. Section 05 21 00 - Steel Joist Framing.
- B. Section 05 31 00 - Steel Decking: Support framing for small openings in deck.
- C. Division 09 - Finishes: Finish painting.

1.04 REFERENCE STANDARDS

- A. AISC (MAN) - Steel Construction Manual 2023.
- B. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges 2022.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.
- E. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished 2018.
- F. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- G. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2023.
- H. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength 2021.
- I. ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use 2014 (Reapproved 2020).
- J. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2023.
- K. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts 2021a.
- L. ASTM A992/A992M - Standard Specification for Structural Steel Shapes 2022.

- M. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2023.
- N. ASTM C827/C827M - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures 2023.
- O. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink) 2020.
- P. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength 2023.
- Q. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions 2019.
- R. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength 2020.
- S. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2020.
- T. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification 2021.
- U. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020, with Errata (2023).
- V. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections 2020.
- W. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic) 2019.
- X. SSPC-SP 1 - Solvent Cleaning 2015, with Editorial Revision (2016).
- Y. SSPC-SP 3 - Power Tool Cleaning 2018.
- Z. SSPC-SP 6 - Commercial Blast Cleaning 2007.
- AA. UL (FRD) - Fire Resistance Directory Current Edition.

1.05 SUBMITTAL

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Shop and Erection Drawings:
 - 1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
 - 2. Connections not detailed.
- C. Show all connections. Connections shall be designed and drawings and calculations shall be Stamped/Sealed by the Professional Structural Engineer, registered in the State of Wisconsin, who is responsible for connection design.
 - 1. Indicate cambers and loads.
 - 2. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
 - 3. Indicate cleaning and painting specifications.
 - 4. Assume responsibility for dimensional errors.
 - 5. Field verify dimensions affected by existing construction prior to submitting shop drawings and so note verified dimensions on shop drawings.
 - 6. Field verify existing anchor bolt placements and modify base plates to accommodate field conditions.
 - 7. Fabricator shall check shop drawings before Submittal.
- D. Shop drawings which include the following and have been prepared under supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located and shall bear seal and signature of supervising design engineer:

1. Calculations, connection drawings, job standards, and any other items that are performance specified or designed by Contractor's engineer.
- E. Provide holes for installation of other work.
 1. Any omission from shop drawings of any materials required by Contract Documents shall not relieve Contractor of responsibility of furnishing and installing such materials, even though shop drawings may have been reviewed and approved.
- F. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
- G. Mill Test Reports: Indicate structural strength, destructive test analysis and non-destructive test analysis.
- H. Materials Test Reports: Submit independent test results or engineered performance analysis of structural thermal-break pad performance in bearing or slip-critical connections where shear and moment loads are applied.
- I. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

1.06 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual."
- B. Maintain one copy of each document on site.
- C. Fabricator: Company specializing in performing the work of this section with minimum ten years of documented experience.
- D. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.
- E. Erector: Company specializing in performing the work of this section with minimum ten years of documented experience.
- F. Design connections not detailed on drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

1.07 FIELD MEASUREMENTS

- A. Verify that field measurements are as shown on Drawings and shop drawings.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Steel Angles, Plates, Channels, and and Other Rolled Members: ASTM A36/A36M, $F_y = 36$ ksi.
- B. Steel W Shapes and Tees: ASTM A992/A992M, $F_y = 50$ ksi..
- C. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade C.
- D. Pipe: ASTM A53/A53M, Grade B, Finish black.
- E. Shear Stud Connectors: Made from ASTM A108 Grade 1015 bars, $F_u = 60$ ksi. Forged Steel, headed and uncoated..
- F. Sag Rods: ASTM A36/A36M.
- G. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436/F436M washers, head markings on bolts, fully traceable:
 1. Manufacturers:
 - a. Nucor Fastener.
 - b. St. Louis Screw & Bolt Co.
 - c. Hayden Bolts.
 - d. Approved Equal.
- H. Tension Control Bolts: Twist-off type; ASTM F3125/F3125M.

- I. Threaded Anchor Bolts (Anchor Rods): ASTM F1554, Class 2A threads; Grade 36; straight; headless with ASTM A563 heavy hex nuts, and ASTM F436, Type 1 washers.
- J. Electrodes: E70XX and shall comply with AWS D1.1; type required for materials being welded.
- K. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- L. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 - 1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
 - 2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.
- M. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.
- N. Touch-Up Primer for Galvanized Surfaces: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.
- O. Drilled anchors shall be as indicated on the Drawings as manufactured by HILTI or approved equal.

2.02 FABRICATION

- A. Shop fabricate to greatest extent possible.
- B. Fabricate items of structural steel in accordance with AISC specifications and as shown on approved shop drawings.
- C. Field connections are to be bolted unless welded, or other types of connections are indicated.
- D. Bolted connections shall be made with ASTM F3125 high strength bolts, unless otherwise noted.
- E. Connections shall support a minimum of one-half the total uniform load capacity shown in the AISC ASD tables for allowable loads on beams for the given shape, span, and steel specified, unless otherwise noted.
- F. Connections shall support a minimum of one half of the maximum total factored uniform load capacity shown in the AISC LRFD tables for factored loads on beams for the given shape, span, and steel specified, unless otherwise noted.
- G. Connections shall be made with standard double angles unless otherwise shown.
- H. Install high strength threaded fasteners in accordance with RCSC "Specifications for Structural Joints Using ASTM F3125 bolts".
- I. Welding shall comply with AISC and AWS Codes for procedures, appearance, quality of welds, and for methods used in correcting welding work.
- J. All welds shall be made by AWS pre-qualified welders, certified for welds made.
- K. Minimum size of fillet welds shall be as specified in TABLE J2.4 of AISC Manual of Steel Construction.
- L. Minimum Strength of Welded Connections: Unless noted otherwise on drawings, all shop and field welds shall develop full tensile strength of member of element joined.
- M. All members with moment connections, noted on drawings, shall be welded to develop full flexural capacity of member, unless noted otherwise on drawings.
- N. Provide holes required for securing other work to structural steel framing and for passage of other work through steel members, as shown on approved shop drawings.
- O. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.
- P. Verify or supplement dimensions shown on Drawings by field measurements to assure fit of new work.

2.03 FINISH

- A. Prepare interior structural component surfaces in accordance with SSPC-SP 1 and SSPC-SP 3.
- B. Prepare structural component surfaces of exterior steel in accordance with SSPC - SP1 and SP6 as a minimum.
- C. Coated surfaces, interior or exterior, shall be prepared in accordance with coating manufacturer's SSPC requirements if more stringent than listed above.
- D. Shop Primed Structural Steel Members: Minimum one coat for interior steel, minimum two coats for exterior steel. Prime coats shall be a minimum of 2.4 mils dry thickness unless the manufacturer has more stringent requirements.
- E. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, unless coated with a weldable primer.
- F. Galvanize structural steel members to comply with ASTM A123/A123M.
 - 1. Provide minimum 2.0 oz/sq ft, (3.4 mils) galvanized coating for members 3/16-inch to 1/4-inch thick, and 2.3 oz/sq ft, (3.9 mils) for members greater than or equal to 1/4-inch.

PART 3 EXECUTION**3.01 PREPARATION**

- A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.
- B. Verify anchors and anchor rods have been preset into connection work in accordance with Drawings and shop drawings.
- C. Beginning of installation and erection means that existing conditions have been checked and found acceptable.
- D. Cost of corrections shall be borne by this Section if variances are not identified prior to start of installation.

3.02 ERECTION

- A. Erect structural steel in compliance with AISC 303.
- B. Store steel on site on substantial shores or blocking to keep free of ground and to prevent bending, buckling, or twisting.
- C. Prevent water collection on members.
- D. Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- E. Field weld components and shear studs indicated the Drawings and on shop drawings.
- F. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts".
- G. Do not field cut or alter structural members without prior approval of Professional Structural Engineer of Record.
- H. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
- I. All bolted joints may be installed as Snug Tightened joints as specified and permitted in the RCSC Specification, unless otherwise noted.
- J. Pretension all high strength bolts for Pretension or Slip-Critical (S.C.) Joints to minimum bolt pretension specified in Table 8.1 of RCSC - Specification for Structural Joints Using ASTM F3125 Bolts, Current Edition.

- K. Clean and prime welds, bolt and rivet heads, abrasions of prime coat, and surfaces not previously shop primed or galvanized, except surfaces to be in contact with concrete after erection.
- L. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for non-shrink grout. Trowel grout surfaces smooth, splaying neatly to 45 degrees.
- M. Contact surfaces of field connections shall be free from dust, oil, loose scale, burrs, pits, and other defects that prevent solid seating of parts.
- N. Clean all surfaces of dirt, mud, oil, or grease that would impair bonding of fireproofing or concrete.
- O. Reaming is not allowed if reaming weakens or makes it impossible to fill holes or adjust accurately after being reamed.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset from True Alignment: 1/4 inch.

3.04 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 45 16-Field Quality Control Procedures for City of Madison requirements.

END OF SECTION

**SECTION 05 21 00
STEEL JOIST FRAMING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Open web steel joists, with bridging, attached seats, chord and anchors.
- B. Loose bearing members, such as plates or angles, and anchor bolts for site placement.

1.02 RELATED REQUIREMENTS

- A. Applicable provisions of Division 01 - General Requirements shall govern all work under this Section.
- B. Section 03 31 00 - Structural Concrete.
- C. Section 04 20 11 - Concrete Unit Masonry.
- D. Section 05 12 00 - Structural Steel Framing.
- E. Section 05 31 00 - Steel Decking.
- F. Section 09 00 00- Finishes.

1.03 REFERENCE STANDARDS

- A. AISC - Steel Construction Manual, Current Edition.
 - B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
 - C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
 - D. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished; 2018.
 - E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2023.
 - F. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength 2021.
 - G. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts 2021a.
 - H. ASTM A563M - Standard Specification for Carbon and Alloy Steel Nuts (Metric) 2021a.
 - I. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength 2023.
 - J. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions 2019.
 - K. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification 2021.
 - L. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020, with Errata (2023).
 - M. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172 2019.
 - N. SJI 100 - Standard Specifications for K-Series, LH-Series, and DLH-Series Open Web Steel Joists, and for Joist Girders 2020.
 - O. SJI Technical Digest No. 9 - Handling and Erection of Steel Joists and Joist Girders 2008.
 - P. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer 2004.
 - Q. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.
 - R. SSPC-SP 2 - Hand Tool Cleaning 2018.
 - S. SSPC-SP 3 - Power Tool Cleaning; 2018.
 - T. UL (FRD) - Fire Resistance Directory; Current Edition.
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1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Shop Drawings which include the following and have been prepared under supervision of a Professional Engineer registered in the State of Wisconsin and shall bear seal and signature of supervising design engineer:
 - 1. Indicate standard designations, joist coding, configurations, sizes, spacings, cambers, locations of joists, joist leg extensions, bridging, connections, and attachments.
- C. Joist design submittal shall be sealed by Professional Engineer experienced in design of this work and registered in State of Wisconsin, and submitted for approval prior to the start of construction.
- D. Designs shall include loads indicated in details and loading diagrams indicated on Drawings.

1.05 QUALITY ASSURANCE

- A. Design connections not detailed on drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- B. Perform Work, including that for headers and other supplementary framing, in accordance with SJI 100 Standard Specifications Load Tables and SJI Technical Digest No. 9.
- C. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and dated no more than 12 months before start of scheduled welding work.
- D. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.
- E. Erector Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 01 60 00 – Product Requirements and to SJI requirements.
- B. Store steel joists and joist girders on substantial shores or blocking to keep free of ground and to prevent bending, buckling, or twisting.
- C. Prevent water collection in members.

1.07 FIELD MEASUREMENTS

- A. Verify that field measurements are as shown on Drawings and shop drawings.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Steel Joists:
 - 1. Canam Group Inc: www.canam-steeljoists.ws
 - 2. Nucor-Vulcraft Group: www.vulcraft.com/#sle.
 - 3. New Millenium: www.newmill.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 MATERIALS

- A. Open Web Joists: SJI Type K Joists:
 - 1. Provide bottom chord extensions as indicated.
 - 2. Minimum End Bearing on Steel Supports: Comply with referenced SJI standard.
 - 3. Minimum End Bearing on Concrete or Masonry Supports: Comply with referenced SJI standard.
 - 4. Finish: Shop primed.
 - B. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436/F436M washers.
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- C. Structural Steel For Supplementary Framing and Joist Leg Extensions: ASTM A992.
- D. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- E. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.03 FABRICATION

- A. Fabricate steel joists and joist girders in accordance with approved shop drawings and SJI Standard Specification.
- B. Provide sloped bearing ends where joist or joist girders slope exceeds 1/4 inch in 12 inches.
- C. Provide bearing lengths per SJI requirements unless greater bearing lengths are shown on Drawings.
- D. Provide bottom and top chord extensions as indicated on Drawings and as required.
- E. Provide either an extended bottom chord element or a separate unit to suit manufacturer's standards, of sufficient strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surfaces, unless otherwise indicated.
- F. Camber joists in accordance with Steel Joist Institute (SJI) specifications.
- G. Drill holes in chords necessary for attachment of wood nailers.
- H. All joists shall be fabricated with top and bottom chords made with angles.

2.04 FINISH

- A. Shop prime joists as specified.
 - 1. Do not prime surfaces that will be fireproofed, field welded, or in contact with concrete.
- B. Prepare surfaces to be finished in accordance with SSPC-SP 2.

PART 3 EXECUTION

3.01 ERECTION

- A. Erect steel joists and joist girders in accordance with approved shop drawings and SJI Standard Specifications and SJI Technical Digest #9.
- B. Allow for erection loads. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment until completion of erection and installation of permanent bridging and bracing.
- C. Coordinate the placement of anchors in concrete for securing loose bearing members furnished as part of the work of this section.
- D. After joist and joist girder alignment and installation of framing, field weld joist seats to steel bearing surfaces.
 - 1. Type K & KCS Joists - Minimum 3/16 inch by 2 inch weld each side of seat.
 - 2. Type LH, DLH & SLH Joists - Minimum 1/4 inch by 2 inch weld each side of seat.
 - 3. Joist Girders - Minimum 1/4 inch by 2 inch weld each side of seat, or 2-3/4 inch diameter HS bolts.
 - 4. Welded Connections listed are minimum. See Drawings for additional details and requirements.
- E. Position and field weld joist chord extensions and wall attachments as detailed.
- F. Do not connect joist girder bottom chords until all dead load is in place.
- G. Do not permit erection of decking until joists are braced, bridged, and secured or until completion of erection and installation of permanent bridging and bracing.
- H. Do not field cut or alter structural members without approval of joist manufacturer and design professional.
- I. After erection, clean and prime welds, damaged shop primer, damaged galvanizing, and surfaces not shop primed, except surfaces specified not to be primed.

3.02 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch.
- B. Maximum Offset From True Alignment: 1/4 inch.

3.03 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 45 16-Field Quality Control Procedures for City of Madison requirements.

END OF SECTION

**SECTION 05 31 00
STEEL DECKING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Steel roof deck and accessories.
- B. Supplementary framing for openings up to and including 18 inches.
- C. Bearing plates and angles.
- D. Formed steel closure plates, eave, ridge and valley plates, and cant strips.
- E. Roof drain sump pans.

1.02 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION:

- A. Division 07 – Thermal and Moisture Protection: Acoustic deck insulation.

1.03 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete topping over metal deck.
- B. Section 03 30 00 - Cast-in-Place Concrete: Placement of anchors for bearing plates and angles cast in concrete.
- C. Section 04 20 00 - Unit Masonry: Placement of anchors for bearing plates embedded in unit masonry assemblies.
- D. Section 05 12 00 - Structural Steel Framing: Support framing for openings larger than 18 inches and shear stud connectors.
- E. Section 05 12 00 - Structural Steel Framing: Placement of embedded steel anchors for bearing plates in cast-in-place concrete.
- F. Section 05 21 00 - Steel Joist Framing: Placement of embedded steel anchors for bearing plates and joist seats in cast-in-place concrete.
- G. Section 07 81 00 - Applied Fire Protection: Spray applied fireproofing.
- H. Division 22 – Plumbing: Reinforcement pans with floor drain hub assemblies.
- I. Division 23 – Heating, Venting and Air Conditioning: Reinforcement pans with floor drain hub assemblies.
- J. Division 26 – Electrical: Electrical and telephone floor outlets, sleeves, gaskets, raceway, and covers

1.04 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
 - B. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished 2018.
 - C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
 - D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2023.
 - E. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2023.
 - F. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification 2021.
 - G. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020, with Errata (2023).
 - H. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel 2018, with Errata (2022).
 - I. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172 2019.
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- J. ICC-ES AC43 - Acceptance Criteria for Steel Deck Roof and Floor Systems 2022.
- K. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks 2007.
- L. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer 2004.
- M. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic) 2019.
- N. UL (FRD) - Fire Resistance Directory Current Edition.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.
- C. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories. Indicate temporary shoring of decking where required.
- D. Manufacturer's Certificates: Certify that products furnished meet or exceed specified requirements.
- E. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

1.06 QUALITY ASSURANCE

- A. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.3/D1.3M and dated no more than 12 months before start of scheduled welding work.
- B. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.
- C. Installer Qualifications: Company specializing in performing the work of this Section with minimum 5 years of experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and protect products to site under provisions of Section 01 60 00 – Product Requirements.
- B. Site Storage: Steel deck shall be stored off ground with one end elevated to provide drainage and shall be protected from elements with a waterproof covering, ventilated to avoid condensation.

1.08 FIELD MEASUREMENTS

- A. Verify that field measurements are as shown on shop drawings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Steel Deck:
 - 1. Canam Steel Corporation: www.canam-steeljoists.ws.
 - 2. Cordeck, Inc: www.cordeck.com/#sle.
 - 3. Nucor-Vulcraft Group: www.vulcraft.com/#sle.
 - 4. Epic Metals Corporation: www.epicmetals.com/
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
 - 6. Steel deck manufacturer and type shall be listed in the FM Global approval Guide.

2.02 STEEL DECK

- A. Roof Deck: Non-composite type, fluted steel sheet:
 - 1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G60/Z180 galvanized coating.
 - 2. Span Design: Double Triple span where possible (minimum double span).

3. Minimum Base Metal Thickness: 22 gauge, 0.0299 inch.
4. Nominal Height: 1-1/2 inch.
5. Profile: Fluted; SDI WR.
6. Formed Sheet Width: 36 inch.
7. Side Joints: Lapped, mechanically fastened.
8. End Joints: Lapped, welded.

2.03 ACCESSORY MATERIALS

- A. Bearing Plates and Angles: ASTM A36/A36M steel, galvanized per ASTM A123/A123M.
- B. Welding Materials: AWS D1.1/D1.1M.
- C. Fasteners: Carbon steel, self-tapping screws. Framing connections - #12 minimum; deck stitch connections - #10 minimum.
- D. Fasteners: Galvanized hardened steel, self tapping.
- E. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- F. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.
- G. Framed Openings: ASTM A36 Structural Steel; $F_y = 36$ ksi.

2.04 FABRICATED DECK ACCESSORIES

- A. Sheet Metal Deck Accessories: Metal closure strips, wet concrete stops, and cover plates, 20 gauge, 0.0359 inch thick sheet steel; of profile and size as indicated; finished same as deck.
- B. Cant Strips: Formed sheet steel, 20 gauge, 0.0359 inch minimum thickness, 45 degree slope, 3-1/2 inch nominal width and height, flange for attachment.
- C. Roof Sump Pans: Formed sheet steel, 14 gauge, 0.0747 inch minimum thickness, flat bottom, sloped sides, recessed 1-1/2 inches below roof deck surface, bearing flange 3 inches wide, sealed watertight.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Beginning of installation means erector accepts existing conditions.

3.02 INSTALLATION

- A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.
- B. On concrete and masonry surfaces provide minimum 4 inch bearing.
- C. On steel supports provide minimum 1-1/2 inch bearing.
- D. Fasten deck to steel support members at ends and intermediate supports as indicated on Drawings. Fasten floor deck at 12 inches on center maximum and roof deck at 6 inches on center maximum, parallel with the deck flute and at each transverse flute using methods specified.
 1. Welding: Use fusion welds through weld washers.
- E. Stitch fastening of deck shall be #10 self-tapping screws, minimum.
- F. At mechanically fastened male/female side laps fasten at 36 inches on center maximum.
- G. Weld deck in accordance with AWS D1.3/D1.3M. Weld size minimum 5/8-inch diameter puddle weld.
- H. At deck openings from 6 inches to 18 inches in size, provide 2 by 2 by 1/4 inch steel angle reinforcement. Place angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and fusion weld to deck at each flute.
- I. At deck openings greater than 18 inches in size, provide steel angle reinforcement. as specified in Section 05 12 00.

- J. At openings between deck and walls, columns, and openings, provide sheet steel closures and angle flashings to close openings.
- K. Close openings above walls and partitions perpendicular to deck flutes with single row of foam cell closures.
- L. Place metal cant strips in position and fusion weld.
- M. Position roof drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.
- N. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.
- O. Butt deck ends over supports when stud shear connections are used.

END OF SECTION

**SECTION 05 40 00
COLD-FORMED METAL FRAMING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Formed steel stud exterior wall framing.
- B. Exterior wall sheathing.
- C. Formed steel joist and purlin framing and bridging.
- D. Water-resistive barrier over sheathing.

1.02 RELATED REQUIREMENTS

- A. Section 05 31 00 - Steel Decking.
- B. Section 06 10 00 - Rough Carpentry: Wood blocking and miscellaneous framing.
- C. Section 06 10 00 - Rough Carpentry: Wall sheathing.
- D. Section 07 21 00 - Thermal Insulation: Insulation within framing members.
- E. Section 07 62 00 - Sheet Metal Flashing and Trim: Head and sill flashings.
- F. Section 07 92 00 - Joint Sealants.
- G. Section 09 21 16 - Gypsum Board Assemblies: Cold-formed steel nonstructural framing.
- H. Section 09 21 16 - Gypsum Board Assemblies: Gypsum-based sheathing.
- I. Section 09 22 16 - Non-Structural Metal Framing.
- J. Section 09 51 00 - Acoustical Ceilings: Ceiling suspension system.

1.03 REFERENCE STANDARDS

- A. AISI S201 - North American Standard for Cold-Formed Steel Framing - Product Data; 2017.
- B. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).
- C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- E. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.
- F. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.
- G. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.
- H. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- I. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
- J. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with work of other sections that is to be installed in or adjacent to metal framing systems, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by affected installers.

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide data on cold-formed steel structural members; include material descriptions and base steel thickness.
- C. Product Data: Provide manufacturer's data on factory-made connectors and mechanical fasteners, showing compliance with requirements.
- D. Shop Drawings:
 - 1. Indicate component details, framed openings, bearing anchorage and hold down devices, loading, strapping, bracing, bridging, blocking, welds, type and location of fasteners, and accessories or items required of related Work.
 - 2. Indicate stud layout, using cross sections, plans and/or elevations to show spacing, sizes and thickness.
 - 3. Describe method for securing studs and joists to tracks and for bolted or welded framing connections.
 - 4. Submit calculations for loading and stresses of wall studs under Professional Engineer's seal and signature. Include deflection requirements and connection components.
- E. Steel Framing Industry Association (SFIA) Certification:
 - 1. Submit documentation that metal studs and connectors used on project meet or exceed requirements of International Building Code.
 - 2. Submit current documentation of contractor accreditation and installer certification. Keep copies of each on-site during and after installation, and present upon request.
 - 3. Design Data:
 - a. Shop drawings signed and sealed by a professional structural engineer.
 - 4. Design calculations sufficient to demonstrate compliance with design criteria; signed and sealed by a professional structural engineer.
 - 5. Manufacturer's Installation Instructions: Provide installation instructions for connectors.
- F. Manufacturer's Qualification statement.
 - 1. Mill Certifications: Submit mill certifications for steel delivered to site. Certify steel bare metal thickness in 0.001 inch, yield strength, tensile strength, total elongation in 2 inch or 8 inch gauge length, chemical analysis, and galvanized coating thickness.

1.06 QUALITY ASSURANCE

- A. See Section 01 45 16-Field Quality Control Procedures for City of Madison requirements.
- B. Designer Qualifications: Design framing system under direct supervision of a professional structural engineer experienced in designing this work and licensed in the State in which the Project is located.
- C. SFIA Code Compliance Certification Program: www.CFsteel.org/#sle: Use metal studs and connectors certified for compliance with International Building Code.
- D. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum three years of documented experience.
- E. Manufacturer Qualifications: Member of Steel Stud Manufacturers Association (SSMA): www.ssma.com/#sle.
- F. Professional Contractor and Truss Fabricator Qualifications: SFIA-accredited contractor and fabricator: www.CFsteel.org/#sle.
- G. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.

1.07 MOCK-UPS

- A. See Section 01 45 16-Field Quality Control Procedures for City of Madison requirements.
 - B. See Section 01 43 39 - Mockups
-

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Structural Framing:
 - 1. CEMCO: www.cemcosteel.com/#sle.
 - 2. ClarkDietrich: www.clarkdietrich.com/#sle.
 - 3. Jaimes Industries: www.jaimesind.com/#sle.
 - 4. SCAFCO Corporation: www.scafco.com/#sle.
 - 5. Steel Construction Systems: www.steelconsystems.com/#sle.
 - 6. The Steel Network, Inc: www.SteelNetwork.com/#sle.
 - 7. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Connectors:
 - 1. Same manufacturer as metal framing.
 - 2. ClarkDietrich: www.clarkdietrich.com/#sle.
 - 3. Simpson Strong Tie: www.strongtie.com/#sle.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with applicable building code criteria for loads, including seismic loads.
 - 1. Maximum Allowable Deflections:
 - a. Exterior Wall Framing for Metal Panels: Horizontal deflection of L/360 of the wall height, 1-inch maximum, and not to exceed 1/4" at window openings.
 - b. Interior Non-Load Bearing Wall Framing: Horizontal deflection of L/360 of the wall height due to 5 psf internal pressure, 1-inch maximum.
 - c. Interior Load-Bearing Wall Framing: Horizontal deflection of L/360 of the wall height due to 5 psf internal pressure, 1-inch maximum.
 - 2. Size components to withstand design loads as indicated on the Drawings.

2.03 MATERIALS

- A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S240.
 - 1. Structural Grade: As required to meet design criteria.
 - 2. Corrosion Protection Coating Designation: CP 60 in accordance with AISI S240.

2.04 STRUCTURAL FRAMING COMPONENTS

- A. Wall Studs and Track Sections: AISI S240; c-shaped studs and u-shaped track sections in stud-matching nominal width and compatible height.
- B. Jamb Studs: AISI S240; manufactured, engineered, c-shaped with wide flanges, designed to replace conventional double-stud framing at openings.
- C. Headers: AISI S240; manufactured, engineered one-member or two-member assemblies, with wide flanges, designed to replace conventional box or nested header framing at openings.
 - 1. Jamb Mounting Clips: Manufacturer's standard.

2.05 MISCELLANEOUS CONNECTIONS

- A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot-dip galvanized per ASTM A153/A153M.
 - 1. Products:
 - a. ITW Commercial Construction North America; ITW CCNA-Buildex Tek's Select Series: www.ITWBuildex.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Anchorage Devices: Powder actuated.
- C. Welding: Comply with AWS D1.1/D1.1M.

2.06 SHEATHING

- A. Gypsum Board Wall Sheathing: See Section 09 21 16.
- B. Wall Sheathing: See Section 06 10 00.

2.07 ACCESSORIES

- A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.
- B. Plates, Gussets, Clips: Formed Sheet Steel, thickness determined for conditions encountered; finish to match framing components.
- C. Galvanizing Repair: Touch up bare steel with zinc-rich paint in compliance with ASTM A780/A780M.
- D. Water-Resistive Barrier: See Section 07 25 00.
- E. Insulating Metal Stud Sill Sealer Gasket:
 - 1. Materials:
 - a. Neoprene Closed Cell Foam.
 - b. EPDM.
 - 2. Sizes: to match the stud widths as indicated on the drawings.
 - 3. Thickness: 1/4 inch.
 - 4. Products:
 - a. Conservation Technology EPDM Sill Gasket
 - b. Thunder Technologies Neoprene
 - c. BRP Manufacturing Neoprene

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify field measurements and adjust installation as required.

3.02 PREPARATION

- A. Structural Wall Foundations: For gaps between wall bottom track and top of foundation 1/4 inch (6.4 mm) or greater, level substrate with loadbearing shims or grout between track and foundation.

3.03 INSTALLATION - GENERAL

- A. Install structural members and connections in compliance with ASTM C1007.

3.04 INSTALLATION OF STUDS

- A. Install wall studs plumb and level.
 - B. Place studs at 16 inches (400 mm) (maximum) on center; not more than 2 inches (50 mm) from abutting walls and at each side of openings. Connect studs to tracks using clip and tie method.
 - C. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.
 - D. Install load-bearing studs full length in one piece. Splicing of studs is not permitted.
 - E. Install load-bearing studs; brace, and reinforce to develop full strength and achieve design requirements.
 - F. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.
 - G. Install intermediate studs above and below openings to align with wall stud spacing.
 - H. Provide deflection allowance in stud track, directly below horizontal building framing at non-loadbearing framing.
 - I. Attach cross studs to studs for attachment of fixtures anchored to walls.
-

- J. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
- K. Touch-up field welds and damaged corrosion-protected surfaces zinc-rich paint in compliance with ASTM A780/A780M.
- L. Touch-up field welds and damaged corrosion protected surfaces with primer.

3.05 INSTALLATION OF WALL SHEATHING

- A. Install wall sheathing with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using self-tapping screws.
 - 1. Provide steel diagonal bracing at corners with foam insulation or gypsum board wall sheathing.
 - 2. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges, and ends.

3.06 FIELD QUALITY CONTROL

- A. See Section 01 45 16-Field Quality Control Procedures for City of Madison requirements.
- B. Provide inspections for welding, mechanical fastening, and cold-formed steel light-frame construction in accordance with requirements of AISI S240.

3.07 TOLERANCES

- A. Studs - Vertical Alignment (Plumbness): 1/960 of span or 1/8 inch in 10 ft (3.2 mm in 3000 mm), in accordance with ASTM C1007.
- B. Studs - Maximum Variation from True Position: 1/8 inch (3.2 mm) in accordance with ASTM C1007.
- C. Stud Spacing: 1/8 inch (3.2 mm) from the designated spacing, provided that the cumulative error does not exceed the requirements of the finishing materials in accordance with ASTM C1007.

END OF SECTION

**SECTION 05 50 00
METAL FABRICATIONS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop fabricated steel and aluminum items.

1.02 RELATED REQUIREMENTS

- A. Section 05 12 00 - Structural Steel Framing: Structural steel column anchor bolts.
- B. Section 05 21 00 - Steel Joist Framing: Structural joist bearing plates, including anchorage.
- C. Section 05 31 00 - Steel Decking: Bearing plates for metal deck bearing, including anchorage.
- D. Section 05 51 33 - Metal Ladders.

1.03 REFERENCE STANDARDS

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- E. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- F. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- G. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.
- H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- J. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- K. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- L. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.
- M. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- N. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.
- O. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- P. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- Q. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.
- R. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
- S. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

T. SSPC-SP 2 - Hand Tool Cleaning; 2018.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- C. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
 - 2. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.
 - a. Include the following, as applicable:
 - 1) Design criteria.
 - 2) Engineering analysis depicting stresses and deflections.
 - 3) Member sizes and gauges.
 - 4) Details of connections.
 - 5) Support reactions.
 - 6) Bracing requirements.
- D. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
- E. Designer's Qualification Statement.
- F. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 QUALITY ASSURANCE

- A. Design shall be under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.
- C. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
- C. Plates: ASTM A283/A283M.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- E. Slotted Channel Fittings: ASTM A1011/A1011M.
- F. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.
- G. Bolts, Nuts, and Washers: ASTM A307, Grade A, plain.
- H. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.
- I. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- J. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

- K. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 MATERIALS - ALUMINUM

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- B. Sheet Aluminum: ASTM B209/B209M, 5052 alloy, H32 or H22 temper.
- C. Bolts, Nuts, and Washers: Stainless steel.
- D. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.03 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Continuously seal joined members by continuous welds.
- D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- F. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 FINISHES - STEEL

- A. Prime paint steel items.
 - 1. Exceptions: Galvanize items to be embedded in concrete and items to be embedded in masonry.
 - 2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.
- B. Prepare surfaces to be primed in accordance with SSPC-SP2.
- C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- D. Prime Painting: One coat.
- E. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating. (Provide minimum 530 g/sq m galvanized coating.)
- F. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.
- G. Slotted Channel Framing: ASTM A653/A653M, Grade 33.

2.05 FINISHES - ALUMINUM

- A. Interior Aluminum Surfaces: Class I natural anodized.
- B. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.
- C. Apply one coat of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

2.06 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch (3 mm) maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch (1.5 mm).
- C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5 mm).
- D. Maximum Bow: 1/8 inch (3 mm) in 48 inches (1.2 m).

- E. Maximum Deviation From Plane: 1/16 inch (1.5 mm) in 48 inches (1.2 m).

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Furnish setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components as indicated on drawings.
- D. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Obtain approval prior to site cutting or making adjustments not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed , except surfaces to be in contact with concrete.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6 mm) per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch (6 mm).
- C. Maximum Out-of-Position: 1/4 inch (6 mm).

END OF SECTION

**SECTION 05 51 33
METAL LADDERS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Shop-fabricated metal ladders.
- B. Prefabricated ladders.
- C. Prefabricated ship ladders.

1.02 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 22 00 - Unit Prices, for additional requirements.

1.03 REFERENCE STANDARDS

- A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- D. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- F. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.
- G. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.
- H. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- I. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- J. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.
- K. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Shop Drawings:
 - 1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - 2. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

1.05 QUALITY ASSURANCE

- A. Design shall be under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- B. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

PART 2 PRODUCTS**2.01 MATERIALS - STEEL**

- A. Steel Sections: ASTM A36/A36M.
 - B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
-

- C. Plates: ASTM A283/A283M.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- E. Mechanical Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.
- F. Bolts, Nuts, and Washers: ASTM A307, plain.
- G. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- H. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 PREFABRICATED LADDERS

- A. Prefabricated Ladder: Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.
 - 1. Components: Manufacturer's standard rails, rungs, treads, handrails, returns, platforms and safety devices complying with the requirements of the MATERIALS article of this section.
 - 2. Materials: Aluminum; ASTM B211/B211M 6063 alloy, T52 temper.
 - 3. Finish: Mill finish aluminum.
 - 4. Manufacturers:
 - a. Industrial Ladder & Scaffolding, Inc.: www.anyladder.com.
 - b. O'Keeffe's Inc: Model 503: www.okeeffes.com.
 - c. Precision Ladders, LLC; Fixed Aluminium Wall Ladder: www.precisionladders.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Prefabricated Ship Ladder: Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.
 - 1. Components: Manufacturer's standard rails, rungs, treads, handrails, returns, platforms and safety devices complying with the requirements of the MATERIALS article of this section.
 - 2. Materials: Aluminum; ASTM B211/B211M 6063 alloy, T52 temper.
 - 3. Incline: 68 degrees.
 - 4. Finish: Mill finish aluminum.
 - 5. Manufacturers:
 - a. O'Keeffe's Inc; Model 520: www.okeeffes.com/#sle.
 - b. Precision Ladders, LLC; Aluminium Ship Stairs: www.precisionladders.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch (3 mm) maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch (1.5 mm).
- C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5 mm).
- D. Maximum Bow: 1/8 inch (3 mm) in 48 inches (1.2 m).
- E. Maximum Deviation From Plane: 1/16 inch (1.5 mm) in 48 inches (1.2 m).

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components as indicated on shop drawings.
- D. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Obtain approval prior to site cutting or making adjustments not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed , except surfaces to be in contact with concrete.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6 mm) per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch (6 mm).
- C. Maximum Out-of-Position: 1/4 inch (6 mm).

END OF SECTION

SECTION 06 09 10
HOMASOTE TACKABLE WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sound deadening acoustical tackable systems.

1.02 REFERENCES

- A. ASTM E 84-test method for surface burning characteristics of building materials.
- B. ASTM D 1037-test methods of evaluating properties of wood-base fiber and particle panel materials.

1.03 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product data: manufacturer's catalog data, detail sheets and specifications.
- C. Quality assurance/ control submittals.
- D. Manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

- A. A. Manufacturer's qualifications:
 - 1. Minimum 10 years of experience in producing sound-deadening boards of the type specified herein.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging with labels intact until ready for installation.
- B. Inspect the materials upon delivery to assure that specified products have been received. Report damaged material immediately to the delivering carrier and note such damage on the carrier's freight bill of lading.
- C. Store materials in a dry place, indoors, on raised platform protected from weather damage.
- D. Climatize panels to existing moisture conditions and for not less than 24 hours before installation. Comply with manufacturer's recommendations for acclimatization.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Homasote Company; 932 Lower Ferry Road, West Trenton, NJ 08628. Tel: (800) 257-9491. Tel: (609) 883-3300. Fax: (609) 883-3497. Email: sales@homasote.com Website: www.homasote.com
- B. Substitutions: Not permitted.
- C. Provide all sound deadening boards from a single manufacturer.

2.02 MATERIALS

- A. Sound-deadening boards: Homasote PINnacle™440; Physical properties as follows:
 - 1. Thickness: 1/2 inch (13 mm).
 - 2. Density: 26-28 pcf (416-448 kg/cu. m) tested in accordance with ASTM C 209.
 - 3. Tensile Strength: When tested in accordance with ASTM C 209:
 - 4. Parallel: 450-700 psi (3,100-4,830 kPa).
 - a. Transverse: 750-1000 psi (5.1171-6.894 kPa).
 - 5. Hardness (janka ball): 230 lbs (104 kg) tested in accordance with ASTM D 1037.
 - 6. Water Absorption by Volume: When tested in accordance with ASTM C 209:
 - a. 2 hour immersion: 7 percent maximum.
 - 7. Expansion: 50 to 90 percent relative humidity, 0.25 percent in accordance with ASTM C 209.
 - 8. Thermal Resistance: When tested in accordance with ASTM C 209 per ASTM C 518:

- a. R-value: 1.2 for 1/2 inch (13 mm) thick board.
 - b. K-value: .512 Btu-in/ (h ft² °F).
 - 9. Noise reduction coefficient (NRC): 0.20
 - 10. Flame Spread: 76 to 200 tested in accordance with ASTM E 84, Class III or C.
 - 11. Adhesive: APA AFG-01 approved.
 - 12. Wall Panel Fasteners:
 - a. Annular Threaded Nails: Length as required to penetrate into wall studs 3/4 inch (19 mm) minimum.
- B. Finish: as indicated on the material schedules and drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates upon which work will be installed.
- B. Verify framing member spacing complies with manufacturer's requirements depending on substrates and installation methods.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- D. Verify what environmental conditions are, and will continue to be maintained in accordance with manufacturer's recommendations.
- E. Starting work by installer is acceptance of substrate and environmental conditions.

3.02 PREPARATION

- A. Follow manufacturer's instructions by separating and allowing panels to be exposed to environmental temperature and humidity conditions for not less than 24 hours before start of installation.
- B. PINnacle panels must be installed in a clean, dry condition. Do not install wet panels.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install only clean dry panels. Do not install wet panels.
- C. Wall Panel Installation: Space panel joints 1/8 inch (3 mm) apart; 1/4 inch (6 mm) space at floors, ceilings, and window and door frames.

3.04 ADJUSTING AND CLEANING

- A. Protect installed products until completion of project. Replace panels that cannot be repaired.
- B. B. Clean by light sanding by using 280-320 grit sandpaper.

END OF SECTION

**SECTION 06 10 00
ROUGH CARPENTRY****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Roofing nailers.
- B. Roofing cant strips.
- C. Preservative treated wood materials.
- D. Fire retardant treated wood materials.
- E. Communications and electrical room mounting boards.
- F. Concealed wood blocking, nailers, and supports.
- G. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Setting anchors in concrete.
- B. Section 05 12 00 - Structural Steel Framing: Prefabricated beams and columns for support of wood framing.
- C. Section 07 25 00 - Weather Barriers: Water-resistive barrier over sheathing.
- D. Section 07 27 00 - Air Barriers: Air barrier over sheathing.
- E. Section 07 62 00 - Sheet Metal Flashing and Trim: Sill flashings.
- F. Section 07 72 00 - Roof Accessories: Prefabricated roof curbs.
- G. Section 09 21 16 - Gypsum Board Assemblies: Gypsum-based sheathing.

1.03 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2017).
- D. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
- E. ASTM D2898 - Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010 (Reapproved 2017).
- F. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.
- H. AWPA U1 - Use Category System: User Specification for Treated Wood; 2023.
- I. PS 1 - Structural Plywood; 2019.
- J. PS 20 - American Softwood Lumber Standard; 2021.
- K. SPIB (GR) - Standard Grading Rules; 2021.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide technical data on wood preservative materials.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

1.06 WARRANTY

- A. See Section 01 77 00-Closeout Procedures for additional warranty requirements.
- B. Correct defective work within a two-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS**2.01 GENERAL REQUIREMENTS**

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
 - 2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
- B. Provide wood harvested within a 500 mile (805 km) radius of the project site.
- C. Lumber salvaged from deconstruction or demolition of existing buildings or structures is permitted in lieu of sustainably harvested lumber provided it is clean, denailed, and free of paint and finish materials, and other contamination; identify source.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: S-dry or MC19.
- D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS

- A. Wall Sheathing: Glass mat faced gypsum, ASTM C1177/C1177M, 5/8 inch Type X fire resistant (16 mm Type X fire resistant).
 - 1. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 3. Edges: Square.
 - 4. Products:
 - a. CertainTeed Corporation; GlasRoc Brand: www.certainteed.com/#sle.
 - b. Georgia-Pacific Gypsum; DensGlass Sheathing: www.gpgypsum.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch (19 mm) thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.04 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
 - 2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
-

- 3. Anchors: Toggle bolt type for anchorage to hollow masonry.
- B. Die-Stamped Connectors: Hot dipped galvanized steel, sized to suit framing conditions.
 - 1. For contact with preservative treated wood in exposed locations, provide minimum G185 (Z550) galvanizing complying with ASTM A653/A653M.
- C. Sill Flashing: See Section 07 62 00.
- D. General Purpose Construction Adhesives: Comply with ASTM C557.
- E. Water-Resistive Barrier: See Section 07 25 00.

2.05 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 - 1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
- B. Fire Retardant Treatment:
 - 1. Products:
 - a. Lonza Group; Dricon: www.wolmanizedwood.com/#sle.
 - b. Hoover Treated Wood Products, Inc; PyroGuard and ExteriorFireX: www.frtw.com/#sle.
 - c. Koppers, Inc; FlamePRO: www.koppersperformancechemicals.com/#sle.
 - d. Viance, LLC; D-Blaze: www.treatedwood.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Exterior Type: AWWPA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Do not use treated wood in direct contact with the ground.
 - 3. Interior Type A: AWWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Interior rough carpentry items are to be fire retardant treated.
 - c. Treat rough carpentry items as indicated .
 - d. Do not use treated wood in applications exposed to weather or where the wood may become wet.

PART 3 EXECUTION

3.01 PREPARATION

- A. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to authorities having jurisdiction may be used in lieu of solid wood blocking.
- C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
- F. Provide the following specific nonstructural framing and blocking:
 - 1. Cabinets and shelf supports.
 - 2. Wall brackets.
 - 3. Handrails.
 - 4. Grab bars.
 - 5. Towel and bath accessories.
 - 6. Wall-mounted door stops.
 - 7. Chalkboards and marker boards.
 - 8. Wall paneling and trim.
 - 9. Joints of rigid wall coverings that occur between studs.

3.04 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at each roof opening except where prefabricated curbs are specified and where specifically indicated otherwise; form corners by alternating lapping side members.

3.05 INSTALLATION OF CONSTRUCTION PANELS

- A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.
 - 1. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges and ends.
- B. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches (610 mm) on center on all edges and into studs in field of board.
 - 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 - 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 - 3. Install adjacent boards without gaps.

3.06 TOLERANCES

- A. Framing Members: 1/4 inch (6 mm) from true position, maximum.
- B. Variation from Plane, Other than Floors: 1/4 inch in 10 feet (2 mm/m) maximum, and 1/4 inch in 30 feet (7 mm in 10 m) maximum.

3.07 FIELD QUALITY CONTROL

- A. See Section 01 45 16-Field Quality Control Procedures for City of Madison requirements.

3.08 CLEANING

- A. Waste Disposal: See Section 01 74 19 - Construction Waste Management and Disposal.
 - 1. Comply with applicable regulations.
 - 2. Do not burn scrap on project site.
 - 3. Do not burn scraps that have been pressure treated.
 - 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
- B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

**SECTION 06 20 00
FINISH CARPENTRY****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Finish carpentry items.

1.02 RELATED REQUIREMENTS

- A. Section 06 09 10 - Homasote Tackable Wall Panels.
- B. Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- C. Section 06 41 00 - Architectural Wood Casework: Shop fabricated custom casework.
- D. Section 09 91 23 - Interior Painting: Painting of finish carpentry items.
- E. Section 09 93 00 - Staining and Transparent Finishing: Staining and transparent finishing of finish carpentry items.
- F. Section 12 32 00 Manufactured Wood Casework.
- G. Section 12 36 00-Countertops.

1.03 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.
- B. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2020.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.
- B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.

1.06 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Company with at least one project within the past 5 years with value of woodwork within 20 percent of cost of woodwork for this project.
 - 2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
 - 3. Single Source Responsibility: Provide and install this work from single fabricator.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-fabricated units to project site in original packages, containers or bundles bearing brand name and identification.
- B. Store finish carpentry items under cover, elevated above grade, and in a dry, well-ventilated area not exposed to heat or sunlight.
- C. Protect from moisture damage.

PART 2 PRODUCTS**2.01 FINISH CARPENTRY ITEMS**

- A. Interior Woodwork Items:
 - 1. Suspended Wood Ceiling System: See Section 09 51 26 - Veneered Wood Ceiling Panels.

2.02 SUSTAINABILITY CHARACTERISTICS

- A. Provide sustainably harvested wood, certified or labeled; see Section 01 60 00.
- B. Provide wood harvested within specified radius of project site; see Section 01 60 00.

2.03 SHEET MATERIALS

- A. Hardwood Plywood: Face species as indicated, plain sawn, book matched, medium density fiberboard core; HPVA HP-1 Front Face Grade AA, Back Face Grade 1, glue type as recommended for application.

2.04 FASTENINGS

- A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.
- B. Adhesive for factory-fabricated units: Manufacturer's recommended adhesive for application.
- C. Fasteners: Of size and type to suit application;
- D. Concealed Joint Fasteners: Threaded steel.

2.05 ACCESSORIES

- A. Adhesive: Type recommended by AWI/AWMAC to suit application.
- B. Lumber for Shimming and Blocking: Softwood lumber of indicated species.

2.06 WOOD TREATMENT

- A. Factory-Treated Lumber: Comply with requirements of AWPAC U1 - Use Category System for pressure impregnated wood treatments determined by use categories, expected service conditions, and specific applications.
- B. Fire Retardant Treatment (FR-S Type): Chemically treated and pressure impregnated; capable of providing flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
- C. Provide identification on fire retardant treated material.
- D. Redry wood after pressure treatment to maximum 6 percent moisture content.

2.07 FABRICATION

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify adequacy of backing and support framing.
- B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.
- C. See Section 06 10 00 for installation of recessed wood blocking.

3.02 INSTALLATION

- A. Install factory-fabricated units in accordance with manufacturer's printed installation instructions.
- B. Set and secure materials and components in place, plumb and level.
- C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim to conceal larger gaps.

3.03 TOLERANCES

- A. Maximum Variation from True Position: 1/16 inch (1.6 mm).
-

B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch (0.79 mm).

END OF SECTION

SECTION 06 41 00
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Specially fabricated cabinet units (circulation desk, restroom vanities)
- B. Hardware.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- C. Section 11 51 00 - Book Depository; book drop at circulation desk.
- D. Section 12 36 00 - Countertops.

1.03 REFERENCE STANDARDS

- A. ANSI A135.4 - Basic Hardboard; 2012 (Reaffirmed 2020).
- B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
- C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- E. BHMA A156.9 - Cabinet Hardware; 2020.
- F. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
- C. Product Data: Provide data for hardware accessories.
- D. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches (300 mm) square, illustrating proposed cabinet and shelf unit substrate and finish.
- E. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.
- F. Sustainable Design Submittal: Documentation for sustainably harvested wood-based components.

1.06 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
 - 2. Single Source Responsibility: Provide and install this work from single fabricator.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

1.08 FIELD CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.
-

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Single Source Responsibility: Provide and install this work from single fabricator.

2.02 VANITIES AND ENDWALLS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Faced Vanities and Endwalls: Custom grade.

2.03 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.
- B. Provide sustainably harvested wood, certified or labeled; see Section 01 60 00.
- C. Provide wood harvested within a 500 mile (805 km) radius of the project site.
- D. Wood fabricated from timber recovered from riverbeds or otherwise abandoned is permitted, unless otherwise noted, provided it is clean and free of contamination; identify source; provide lumber re-graded by an inspection service accredited by the American Lumber Standard Committee, Inc.

2.04 PANEL CORE MATERIALS

- A. Medium Density Fiberboard (MDF): Composite panel composed of cellulosic fibers, additives, and bonding system; cured under heat and pressure; comply with ANSI A208.2.
 - 1. Grade: 115; moisture resistance: MR10.
 - 2. Panel Thickness: As indicated on drawings..
- B. Basic Hardboard: Panel manufactured from inter-felted lignocellulosic fibers consolidated under heat and pressure; comply with ANSI A135.4.
 - 1. Class: Tempered.
 - 2. Surface: Smooth one side (S1S).
 - 3. Nominal Thickness: 1/4 inch (6.4 mm).

2.05 LAMINATE MATERIALS

- A. Manufacturers:
 - 1. As noted on Materials Schedule on drawings.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
- C. Provide specific types as indicated.

2.06 COUNTERTOPS

- A. Countertops: See Section 12 36 00.

2.07 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.
- B. Fasteners: Size and type to suit application.
- C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- D. Concealed Joint Fasteners: Threaded steel.
- E. Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color to match adjacent surface.

2.08 HARDWARE

- A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
- B. Countertop Support Brackets: Fixed, L-shaped, face-of-wall mounting. To be used with counters without base cabinets.
 - 1. Materials: Steel; T-shape cross-section.
 - a. Finish: Manufacturer's standard, factory-applied, powder coat.
 - b. Color: As selected from manufacturer's standard offerings.
 - c. Height: 15 inches (380 mm).
 - d. Support Length: 15 inches (380 mm).
 - e. Width: 1-1/2 inches (38 mm).
 - 2. Products:
 - a. Iron Supports; Universal Heavy-Duty Commercial Support Bracket: www.ironsupports.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Vanity Brackets: Fixed, ADA-compliant, face-of-wall mounting.
 - 1. Material and Shape: Steel; formed compound shapes.
 - a. Finish: Manufacturer's standard, factory-applied, textured powder coat.
 - b. Color: As selected from manufacturer's standard offerings.
 - 2. Size: See Drawing details.
 - 3. Products:
 - a. A&M Hardware, Inc; ADA Vanity Brackets: www.aandmhardware.com/#sle.

2.09 FABRICATION

- A. Refer to details on drawings for design intent, specific measurements and finish materials.
- B. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- C. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- D. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- E. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Locate counter butt joints minimum 2 feet from sink cut-outs. (Locate counter butt joints minimum 600 mm from sink cut-outs.)
 - 1. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- F. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and fixtures and fittings. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

2.10 SHOP FINISHING

- A. Sand work smooth and set exposed nails and screws.
- B. For opaque finishes, apply wood filler in exposed nail and screw indentations and sand smooth.
- C. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

- A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- C. Use concealed joint fasteners to align and secure adjoining cabinet units.
- D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim for this purpose.

3.03 ADJUSTING

- A. Test installed work for rigidity and ability to support loads.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

3.05 SCHEDULES

- A. Refer to drawings for material finish schedules.

END OF SECTION

SECTION 06 83 16
FIBERGLASS REINFORCED PANELING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fiberglass reinforced plastic panels.
 - 1. Foundation Liner (over foundation rigid insulation).
- B. Trim.

1.02 RELATED REQUIREMENTS

- A. Section 01 43 39-Mockups.

1.03 REFERENCE STANDARDS

- A. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2022.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Samples: Submit two samples 12 by 12 inch (30.48 x 30.48 cm) in size illustrating material and surface design of panels.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Roll: 1 roll.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Storage material per manufacturer's recommendations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fiberglass Reinforced Plastic Foundation Liner:
 - 1. Basis of Design: Glasteel, A Stabilit Company; www.stabilitamerica.com
 - a. Contact: Tim Lundy, tim.lundy@glasteel.com, 901-508-5320
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PANEL SYSTEMS

2.03 MATERIALS

- A. Foundation Liner: Fiberglass reinforced plastic (FRP), complying with ASTM D5319.
 - 1. Glasliner FRP Foundation Liner
 - a. Thickness: 0.060 inches
 - b. Length: 50 feet (standard roll)
 - c. Widths: 1 foot.
 - d. Color: Black.
 - e. Texture: pebbled
 - f. Resistant to stains, odors, moisture, insects and pests
 - g. Shatter resistant
- B. Liner Accessories: Vinyl; color coordinating with panel.
 - 1. Fasteners: Nylon rivets.
 - 2. Division Bar: length varies
 - 3. Inside Corner Angle: 1-1/4 x 1-1/4 inches

- 4. Outside Corner Angle: 1-1/4 x 1-1/4 inches
- C. Adhesive: Type recommended by panel manufacturer.
- D. Sealant: Type recommended by panel manufacturer; color matching panel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions and substrate flatness before starting work.
- B. Verify that substrate conditions are ready to receive the work of this section.

3.02 INSTALLATION - FOUNDATION LINERS

- A. Install liner in accordance with manufacturer's instructions.
- B. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.
- C. Install panels with manufacturer's recommended gap for panel field and corner joints.
- D. Prior to adhering all surfaces shall be free of dust, dirt, and other foreign matter.
- E. Place trim on panel before fastening edges, as required.
- F. Fill channels in trim with sealant before attaching to panel.
- G. Install trim with adhesive and screws or nails, as required.
- H. Remove excess sealant after paneling is installed and prior to curing.

END OF SECTION

**SECTION 07 05 53
FIRE AND SMOKE ASSEMBLY IDENTIFICATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Identification markings for fire and smoke rated partitions, and fire rated walls.

1.02 RELATED REQUIREMENTS

- A. Section 09 91 23 - Interior Painting: Paint finish.

1.03 REFERENCE STANDARDS

- A. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of marking, indicating font, foreground and background colors, wording, and overall dimensions.
- C. Schedule: Completely define scope of proposed marking, and indicate location of affected walls and partitions, and number of markings.

1.05 QUALITY ASSURANCE

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

1.06 FIELD CONDITIONS

- A. Do not install adhered markings when ambient temperature is lower than recommended by label or sign manufacturer.
- B. Do not install painted markings when ambient temperature is lower than recommended by coating manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Partition Identification Labels:
 - 1. Fire Wall Signs, Inc: www.firewallsigns.com/#sle.
 - 2. Safety Supply Warehouse, Inc: www.safetysupplywarehouse.com/#sle.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 FIRE AND SMOKE ASSEMBLY IDENTIFICATION

- A. Regulatory Requirements: Comply with "Marking and Identification" requirements of "Fire-Resistance Ratings and Fire Tests" chapter of ICC (IBC).
- B. Adhered Fire and Smoke Assembly Identification Signs: Printed vinyl or paper sign with factory applied adhesive backing.
- C. Applied Fire and Smoke Assembly Identification: Identification markings applied to partition with paint and a code compliant stencil. See Section 09 91 23 for products.
- D. Languages: Provide sign markings in English.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.02 PREPARATION

- A. See Section 09 91 23 for substrate preparation for painted markings.
-

3.03 INSTALLATION

- A. Locate markings as required by ICC (IBC).
- B. Install adhered markings in accordance with manufacturer's instructions.
- C. Install applied markings in accordance with Section 09 91 23.
- D. Install neatly, with horizontal edges level.
- E. Protect from damage until Date of Substantial Completion; repair or replace damaged markings.

END OF SECTION

**SECTION 07 21 00
THERMAL INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Board insulation at perimeter foundation wall, underside of floor slabs, over roof deck, and exterior wall behind rainscreen wall finish.
- B. Batt insulation in exterior wall and ceiling construction.

1.02 RELATED REQUIREMENTS

- A. Section 06 83 16 - Fiberglass Reinforced Paneling; foundation liner over rigid insulation.
- B. Section 07 21 19-Foamed-in-Place Insulation.
- C. Section 07 21 19.13-Foamed-in-Place Aminoplast Masonry Foam Insulation.
- D. Section 07 25 00 - Weather Barriers.
- E. Section 07 53 00 - Elastomeric Membrane Roofing: Installation requirements for board insulation over low slope roof deck.

1.03 DEFINITIONS

- A. Mineral Fiber Material Composition: Insulation referred to as mineral fiber block, board, and blanket insulation is composed of fibers from mineral based substances such as rock, slag, or glass and processed from the molten state into fibrous form.
 - 1. Based on type of insulation substance, the material will be referred to as a mineral fiber when having a rock or slag base, and glass fiber with a glass or silica sand base, also considered a mineral.
 - 2. Insulation blankets are flexible units consisting of felted, bonded, or unbonded fibers formed into rolls or flat cut pieces referred to as batts; rolls are simply longer versions of batts.
 - 3. For additional information about mineral fiber and the various classification types, refer to the following reference standards; ASTM C553, ASTM C612, ASTM C665, and ASTM C726.

1.04 REFERENCE STANDARDS

- A. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.
- C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
- E. ASTM C726 - Standard Specification for Mineral Wool Roof Insulation Board; 2017.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
- E. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

1.06 QUALITY ASSURANCE

- A. Air Barrier Association of America (ABAA) Evaluated Materials Program (EAP); www.airbarrier.org/#sle: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.07 MOCKUPS

- A. See Section 01 43 39 - Mockups.

1.08 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS**2.01 APPLICATIONS**

- A. Insulation Under Concrete Slabs: Extruded polystyrene (XPS) board.
- B. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board.
- C. Insulation Over Metal Stud Framed Walls, Continuous: Mineral fiber board.
- D. Insulation in Metal Framed Walls: Batt insulation with no vapor retarder.
- E. Insulation over Roof Deck: Polyisocyanurate board.
- F. Insulation in Deck Pan Flutes: Fibrex Fluted Deck Pan Insulation.

2.02 FOAM BOARD INSULATION MATERIALS

- A. Extruded Polystyrene (XPS) Board Insulation: Comply with ASTM C578 with either natural skin or cut cell surfaces.
 - 1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 - 3. Type and Thermal Resistance, R-value (RSI-value): as indicated on the drawings unless otherwise noted.
 - 4. Products:
 - a. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Extruded Polystyrene (XPS) Continuous Insulation (CI) Board: Comply with ASTM C578, and manufactured using carbon black technology.
 - 1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 - 3. Type and Thermal Resistance, R-value (RSI-value): as indicated on the drawings unless otherwise noted.
 - 4. Board Size: 48 inch by 96 inch (1220 mm by 2440 mm).
 - 5. Board Thickness: as indicated on the drawings.
 - 6. Board Edges: Shiplap, at long edges.

2.03 MINERAL FIBER BOARD INSULATION MATERIALS

- A. Mineral Wool Block and Board Thermal Insulation: Complying with ASTM C612.
 - 1. Facing: None, unfaced.
 - 2. Flame Spread Index: 25 or less, when tested with facing, if any, in accordance with ASTM E84.
 - 3. Smoke Developed Index: 50 or less, when tested with facing, if any, in accordance with ASTM E84.
 - 4. Board Thickness: as indicated on the drawings.
 - 5. Products:
 - a. Rockwool; COMFORTBOARD 110: www.rockwool.com.

- b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Mineral Wool Block, Board, or Blanket Thermal Insulation: Complying with ASTM C612 or ASTM C553.
 - 1. Where indicated, provide foil facing on one side; with flame spread index of 25 or less, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - 3. Board Thickness: as indicated on the drawings.
 - 4. Thermal Resistance: R-value (RSI-value) as indicated on the drawings.
 - 5. Products:
 - a. Owens-Corning ThermaFiber, Inc; RainBarrier 45: www.owenscorning.com.

2.04 MINERAL FIBER BLANKET INSULATION MATERIALS

- A. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
 - 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - 3. Thermal Resistance: R-value (RSI-value) as indicated on the drawings.
 - 4. Thickness: as indicated on the drawings
 - 5. Products:
 - a. ROCKWOOL; COMFORTBATT: www.rockwool.com/#sle.
 - b. ROCKWOOL; AFB: www.rockwool.com/#sle.
 - c. ROCKWOOL; AFB evo™: www.rockwool.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

2.05 ACCESSORIES

- A. Tape: Reinforced polyethylene film with acrylic pressure sensitive adhesive.
 - 1. Application: Sealing of interior circular penetrations, such as pipes or cables.
 - 2. Width: Are required for application.
- B. Self-Adhered Transition Flashing: Multipurpose, self-adhered flashing with modified butyl adhesive, polyester fiber top sheet, and polypropylene interlayer.
 - 1. Application: Primerless adhesion for use as through-wall flashings and wall transitions to roof and below-grade systems.
 - 2. Thickness: 45 mil, 0.045 inch (1.14 mm), nominal.
 - 3. Size: 6 inches (152 mm) wide, in rolls 75 feet (23 m) long.
- C. Flashing Tape: Special reinforced film with high performance adhesive.
 - 1. Application: Window and door opening flashing tape.
 - 2. Width: As required for application.
- D. Sill Plate Sealer: Closed-cell foam tape with rubberized adhesive membrane; bridges gap between foundation structure and sill plate or skirt board.
 - 1. Width: 6 inches (156 mm).
 - 2. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 30 days of weather exposure.
- E. Tape joints of rigid insulation in accordance with roofing and insulation manufacturers' instructions.
- F. Air and Moisture Sealing Insulation Fasteners: Preassembled fastener units consisting of sealing washer, screw, and gasketing tube.
- G. Infill Strips:
 - 1. High-performance insulation, PIR or XPS.
- H. Mineral Wool Insulation Attachment:
 - 1. Products:

- a. TruFast Walls, a Division of Altenloh, Brinck & Co. US, Inc; Grip-Lok MW Plate: www.trufastwalls.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- I. Rigid Insulation Pronged Attachment Washers: Solid plastic cap washer with prongs and flexible perimeter seal attached with screws to substrate for attachment of rigid insulation and to help seal against air and moisture penetration through weather barrier assembly.
- J. Support for Cladding and Continuous Insulation: See respective cladding section.
- K. Support for Cladding and Continuous Insulation: Continuous thermal Z-girts.
 - 1. Fiberglass reinforced plastic (FRP) girts that provide cladding attachment support for exterior wall cladding, brick veneer, CMU veneer, metal wall panels, and siding.
 - 2. Fasteners: As recommended by clip manufacturer.
 - 3. Products:
 - a. Armatherm; Z Girt Structural Thermal Break: www.armatherm.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER

- A. Install boards horizontally on foundation perimeter.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.03 BOARD INSTALLATION AT EXTERIOR WALLS

- A. Install boards horizontally on walls.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.04 BOARD INSTALLATION USING CLADDING AND CONTINUOUS INSULATION SUPPORTS

- A. Install supports in accordance with manufacturer's installation instructions.
- B. Install supports in compliance with system orientation, sizes, and locations as indicated on drawings and in accordance with approved shop drawings.
- C. Install supports to fill in exterior wall spaces without gaps or voids in insulation.
- D. Trim insulation neatly to fit spaces and provide a continuous thermal layer.

3.05 BOARD INSTALLATION UNDER CONCRETE SLABS

- A. Place insulation under slabs on grade after base for slab has been compacted.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- C. Prevent insulation from being displaced or damaged while placing slab.

3.06 BOARD INSTALLATION OVER LOW SLOPE ROOF DECK

- A. Board Installation Over Roof Deck, General:
 - 1. See applicable roofing specification section for specific board installation requirements.
 - 2. Ensure vapor retarder is clean and dry, continuous, and ready for application of roofing system.
 - 3. Fasten insulation to deck in accordance with roofing manufacturer's written instructions and applicable Factory Mutual requirements.
 - 4. Do not apply more insulation than can be covered with roofing on the same day.

3.07 BATT INSTALLATION

- A. Install insulation in accordance with manufacturer's instructions.

- B. Install in interior wall spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.08 FIELD QUALITY CONTROL

- A. See Section 01 45 16-Field Quality Control Procedures for City of Madison requirements.

3.09 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 21 19
FOAMED-IN-PLACE INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Foamed-in-place insulation.
 - 1. In exterior framed walls.
 - 2. In exterior wall crevices.
 - 3. At junctions of dissimilar wall and roof materials.
 - 4. In underside of roofs and ceilings.
 - 5. In underside of floor decks.
 - 6. In indicated door frames.
 - 7. In indicated storefront frames.
 - 8. In structural steel member voids.

1.02 RELATED SECTIONS

- A. Section 07 21 00 - Thermal Insulation.
- B. Section 07 21 19.13 - Foamed-in-Place Aminoplast Masonry Foam Insulation

1.03 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- B. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2019.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.
- D. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
- E. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.
- F. FM 4880 - Evaluating the Fire Performance of Insulated Building Panel Assemblies and Interior Finish Materials; 2017.
- G. NFPA 275 - Standard Method of Fire Tests for the Evaluation of Thermal Barriers; 2022.
- H. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.
- I. UL 1040 - Standard for Safety Fire Test of Insulated Wall Construction; Current Edition, Including All Revisions.
- J. UL 1715 - Standard for Safety Fire Test of Interior Finish Material; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week prior to commencing work of this section.

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection as required by ABAA QAP.
- C. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

- D. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of all contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of documented experience.
- B. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org/#sle:
1. Installer Qualification: Use accredited contractor, certified installers, evaluated materials, and third-party field quality control audit.
 2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.07 MOCK-UPS

- A. See Section 01 43 39-Mockups.

1.08 FIELD CONDITIONS

- A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.
- B. Do not apply foam when temperature is within 5 degrees F (2.78 degrees C) of dew point.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Foamed-In-Place Insulation:
1. BASF Corporation; WALLTITE US Series Closed Cell: www.spf.basf.com/#sle.
 2. Certainteed Insulation; Certaspray: www.certainteed.com.
 3. Carlisle Spray Foam Insulation: www.carlislesfi.com/#sle.
 4. Gaco Western; 183M: www.gaco.com/#sle.
 5. Henry Company: www.henry.com/#sle.
 6. Huntsman Building Solutions; Heatlok HFO Pro: www.huntsmanbuildingsolutions.com/#sle.
 7. Johns Manville; JM Corbond III Closed Cell Spray Polyurethane Foam: www.jm.com/#sle.
 8. NCFI Polyurethanes; ____: www.ncfi.com/#sle.
 9. Preferred Solutions, Inc; ____: www.preferredsolutions.net/#sle.
 10. Rhino Linings Corporation; ThermalGuard CC2: www.rhinolining.com/#sle.
 11. Tremco; EXOAIR LEF: <https://www.tremcosealants.com/>.
 12. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 MATERIALS

- A. Foamed-In-Place Insulation: Medium-density, rigid or semi-rigid, closed cell polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
1. Regulatory Requirements: Comply with applicable code for flame and smoke, concealment, and fire protection requirements.
 - a. Fire Protection: Provide 15-minute thermal barrier of 1/2 inch (12.7 mm) gypsum board or equivalent material complying with NFPA 275 test method, or foamed-in-place insulation either exposed or with covering that complies with FM 4880, NFPA 286, UL 1040, or UL 1715.
 2. Thermal Resistance: R-value (RSI-value) of 5.0 (0.88), minimum, per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature when tested in accordance with ASTM C518.
 3. Water Vapor Permeance: Vapor retarder; 2 perms (115 ng/(Pa s sq m)), maximum, when tested at intended thickness in accordance with ASTM E96/E96M, desiccant method.

4. Water Absorption: Less than 2 percent by volume, maximum, when tested in accordance with ASTM D2842.
5. Air Permeance: 0.04 cfm per square foot (0.2 L/(s/sq m)), maximum, when tested at intended thickness in accordance with ASTM E2178 at 1.57 psf (75 Pa).
6. Closed Cell Content: At least 90 percent.
7. Surface Burning Characteristics: Flame spread/smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.

2.03 ACCESSORIES

- A. Primer: As required by insulation manufacturer.
- B. Soffit Edge Seal: Prefabricated, flexible seal designed for unventilated attic spaces.
 1. Applications: Sealing space between wood framing top plate and underside of roof sheathing.
 2. Material: Polyvinyl chloride (PVC).
 3. Roof Joist/Truss Spacing: 16 inch (406 mm) on center, nominal.
 4. Products:
 - a. Brentwood Industries, Inc; AccuBlock 14-1/2 Inch: www.brentwoodindustries.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify work within construction spaces or crevices is complete before insulation application.
- B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation adhesion.

3.02 PREPARATION

- A. Mask and protect adjacent surfaces from over spray or dusting.
- B. Apply primer in accordance with manufacturer's instructions.

3.03 APPLICATION

- A. Apply insulation in accordance with manufacturer's instructions.
- B. Apply insulation by spray method, to a uniform monolithic density without voids.
- C. Apply to achieve a thermal resistance indicated in the drawings.
- D. Patch damaged areas.
- E. Where applied to voids and gaps assure space for expansion to avoid pressure on adjacent materials that may bind operable parts.
- F. Trim excess away for applied trim or remove as required for continuous sealant bead.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 45 16-Field Quality Control Procedures for City of Madison requirements.
- B. Field inspections and tests will be performed by an independent testing agency.
- C. Inspection will include verification of insulation thickness and density.
- D. Coordination of ABAA Tests and Inspections:
 1. Provide testing and inspection required by ABAA QAP.
 2. Notify in ABAA writing of schedule for air barrier work. Allow adequate time for testing and inspection.
 3. Cooperate with ABAA testing agency.
 4. Allow access to air barrier work areas and staging.
 5. Do not cover air barrier work until tested, inspected, and accepted.

3.05 PROTECTION

- A. Do not permit subsequent construction work to disturb applied insulation.

END OF SECTION

SECTION 07 21 19.13
FOAMED-IN-PLACE AMINOPLAST MASONRY FOAM INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Foam-in-place insulation in core-cells of Concrete Masonry Unit (CMU) walls, wythe cavities of exterior walls.
- B. Foam-in-place sound control insulation for interior and exterior walls.

1.02 RELATED SECTIONS:

- A. Section 04 20 00 – Unit Masonry
- B. Section 07 21 00 - Thermal Insulation.
- C. Section 07 21 19 - Foamed-in-Place Insulation.

1.03 REFERENCED STANDARDS

- A. ASTM E-84 “Standard Test Method for Surface Burning Characteristics of Building Materials.”
- B. ASTM C-518 “Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.”
- C. NFPA 259 “Standard Test Method for Potential Heat of Building Materials”

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Manufacturer’s data on product, including:
 - 1. “Product Information” Sheet from Manufacturer.
 - 2. Safety Data Sheet (SDS) for CfiFOAM Aminoplast Masonry Foam Insulation.
 - 3. Upon request by the Architect, Installer shall provide test data showing compliance of the product with referenced standards.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: A firm with experience installing insulation systems of the type specified and authorized by the foam manufacturer.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Delivery
 - 1. Materials shall be delivered to installer in manufacturer’s original, unopened, undamaged containers with identification labels intact.
 - 2. Installer will blend resin and foaming catalyst according to the manufacturer’s instructions prior to arriving at the jobsite and/or at the jobsite, at the installer’s discretion.
- B. Storage and Handling
 - 1. Materials should be stored in original paper packages and boxes protected from moisture until used by installer.
 - 2. Once blended with water by installer, materials must be maintained at a minimum temperature of 75 degrees F.

1.07 PROJECT/SITE CONDITIONS

- A. The wall assembly must be essentially dry with no standing water in the CMU core cells and no visible wetness on exterior surfaces.
- B. Mortar must be adequately cured prior to installation of foam insulation.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Basis of Design: cfiFOAM, Inc., PO Box 10393, Knoxville, TN 37939.
- B. Telephone: 800-656-3626. Fax: 865-588-6607. Website: www.cfifoam.com.
- C. Occupied and/or soon to be occupied structures and framed structures shall be insulated with InsulSmart Interior Foam Insulation®.
- D. Structures in California, Connecticut, New Jersey and New Hampshire shall be insulated with InsulSmart MH®.
- E. Framed structures shall not be insulated with Core Foam Masonry Foam Insulation®.

2.02 MATERIALS

- A. CfiFOAM Aminoplast Masonry Foam Insulation (Foamed-in-Place)
 - 1. Description: Cellular plastic insulation comprised of a spray-dried polymeric resin and a foaming catalyst concentrate that are combined with water for injection, along with compressed air, into the wall cavity by an authorized installer.
 - 2. Surface Burning Characteristics – ASTM E84: Class A or Class I
 - a. Flame Spread: 25 or Less
 - b. Smoke Generated: Less than 450
 - c. Thickness: 3.5 inches (maximum thickness per test apparatus).
 - d. Tests performed by an independent, accredited laboratory located within the US.
 - 3. Thermal Performance (foam) – ASTM C177 or ASTM C518:
 - a. k-Value: k-0.23/inch @ 75°F mean temperature.
 - b. R-Value: R-4.6/inch @ 75°F mean temperature.
 - 4. Potential Heat – NFPA 259/ASTM D5865: Potential Heat ≤ 80 Btu/lb.
 - 5. Dimensional Stability (Shrinkage)
 - a. % - 12x8x16 CMU Enclosed Core Cell
 - 6. Density of Foam:
 - a. Wet Foam 12" x 12" x 12" box weight: 2-½ to 3-¼ lbs.
 - b. Cured Foam: 0.5-1.0 lbs./ft³

2.03 PRODUCT SUBSTITUTIONS

- A. Substitutions: Equal approved by the Architect.

PART 3 EXECUTION**3.01 GENERAL**

- A. Comply with the instructions and recommendations of the foam-in-place insulation manufacturer.

3.02 EXAMINATION

- A. Site Verification
 - 1. Verify that the wall assembly is essentially dry.
 - 2. Verify that no water is standing in core cells within the wall assembly.
 - 3. Verify that mortar is adequately cured.

3.03 PREPARATION

- A. Select the best location(s) to inject foam:
 - 1. Preferably through wall surfaces to be covered.
 - 2. 5/8 inch - 7/8 inch holes to be drilled in masonry joints or directly through CMU face walls.

3.04 INSTALLATION GUIDELINES

- A. All empty core cells and voids within each insulated wall shall be filled with foam insulation as shown on the drawings.
- B. Walls can be filled using either top-fill or by pressure-injection techniques.
 - 1. For top-fill, the installer must use an extension tube to begin installing foam from the bottom of the cavity, withdrawing the extension tube as foam fills the cavity.
 - 2. For pressure-injection, holes are drilled in each CMU—3/8" holes for visually sensitive areas for use with a low-volume touch-up gun, 5/8" holes for use with a standard foam gun, or 7/8" holes for use with a high-volume production gun—at an approximate height of four feet from finished floor level. Normally each vertical cell column is drilled and injected with foam in 10'-24' lifts.
 - 3. CfiFOAM Aminoplast Masonry Foam Insulation is injected until it completely fills each vertical cell column, as evidenced by foam exiting adjacent injection holes. Repeat steps 1 and 2 at intervals of 10' to 14' above the initial row of injection holes, or as needed, until the wall is completely filled. Exit holes may be drilled beneath bond beams and at tops of walls to help visually verify complete foam filling.
- C. After foam insulation sets, remove excess foam from outside of cavity, sweeping the wall and floor as needed. Cured foam is an inert material and, therefore, can be disposed of with other construction waste or worked into soils on-site in accordance with local regulations.
- D. Patch holes with mortar to resemble adjacent surfaces.

3.05 FIELD QUALITY CONTROL

- A. Testing
 - 1. Verify insulation density by random sampling of foam
 - a. Fill a 12x12x12 box with foam
 - b. Foam weight should be 2 ½ - 3 ¼ lb.
- B. Inspection
 - 1. Verify complete filling of voids by drilling block face upon request.
 - 2. Upon request by the Architect, Installer shall provide IR scans of all insulated masonry walls prepared and interpreted by IR technicians who are "BlockWallScanIR" trained and certified.
 - 3. Correct all portions of the installation not in compliance with the Architect's requirements at no added cost to the Owner.

3.06 PROTECTION

- A. Product should be protected from excess moisture during initial 24-hour curing period after installation. A 72-hour curing period is normally required prior to painting.
- B. Foam should not be exposed to surfaces over 190°F for sustained periods of time.

END OF SECTION

**SECTION 07 25 00
WEATHER BARRIERS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Water-resistive barriers.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Water-resistive barrier under exterior cladding.
- B. Section 07 62 00 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with weather barriers.

1.03 DEFINITIONS

- A. Weather Barriers: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.
- B. Water-Resistive Barrier: A material behind an exterior wall covering that is intended to resist liquid water that has penetrated behind the exterior covering from further intruding into the exterior wall assembly.

1.04 REFERENCE STANDARDS

- A. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.
- B. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay; 2017 (Reapproved 2021).
- C. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
- D. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.
- E. ICC-ES AC212 - Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers over Exterior Sheathing; 2015, with Editorial Revision (2020).

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide data on material characteristics.
- C. Shop Drawings: Provide drawings of special joint conditions.
- D. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.

1.06 MOCK-UPS

- A. See Section 01 43 39 - Mockups

1.07 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by materials manufacturers before, during, and after installation.

PART 2 PRODUCTS**2.01 WATER-RESISTIVE BARRIER MATERIALS**

- A. Water-Resistive Barrier Coating: Fluid-applied air and water-resistive coating for various exterior substrates.
 - 1. Air Permeance, Building Assembly Air Leakage Rate: Not greater than 0.04 cfm/sq ft (0.2 L/sq m) when tested at 1.57 psf (75 Pa) in accordance with ASTM E2357.

2. Air Permeance, Building Material Air Leakage Rate: 0.004 cfm/sq ft (0.02 L/sec sq m) maximum leakage when tested at 1.57 psf (75 Pa) pressure difference in accordance with ASTM E2178.
3. Water-Resistive Barrier over Sheathing Compliance: Complying with ICC-ES AC212.
4. Water Vapor Permeance: Tested in accordance with ASTM E96/E96M.
 - a. Procedure A: Greater than 5 perms (287 ng/(Pa s sq m)).
 - b. Procedure B: Greater than 14 perms (804 ng/(Pa s sq m)).
5. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 120 days of weather exposure.
6. Resistance to Fungal Growth: No growth when tested in accordance with ASTM D5590.
7. System Accessory Products: As recommended by coating manufacturer.
8. Products:
 - a. Grace Construction Products; PERM-A-BARRIER VP LOW TEMP (LT): <https://gcpat.com/en>
 - b. Momentive Performance Materials, Inc/GE Silicones: www.siliconeforbuilding.com/#sle.
 - c. PROSOCO, Inc: www.prosoco.com/#sle.
 - d. Polyguard; Airluk Flex VP: polyguard.com.
 - e. Sto Corp; Sto Gold Coat: <https://www.stocorp.com/>.
 - f. Henry; Air-Bloc 33MR: henry.com.
 - g. GCP; PERM-A-BARRIER VPL Low Temperature: gcpat.com.
 - h. Carlisle; Barritech VP: www.carlisleccw.com.

2.02 ACCESSORIES

- A. Sealants, Tapes, and Accessories Used for Sealing Water-Resistive Barrier and Adjacent Substrates: As indicated or complying with water-resistive barrier manufacturer's installation instructions.
- B. Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement is waived if not installed on a roof.
 1. Width: 4 inches (102 mm).
- C. Liquid Flashing: One part, fast curing, nonsag, elastomeric, gun grade, trowelable liquid flashing.
- D. Thinners and Cleaners: As recommended by water-resistive barrier manufacturer.
- E. Weather Barrier Self-Sealing Flat Attachment Washers: Solid plastic flat cap washers with flexible perimeter seal attached with screws to substrate for attachment of weather barrier to help seal against air and moisture penetration through weather barrier assembly.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and conditions comply with requirements of this section.

3.02 PREPARATION

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
- B. Clean and prime substrate surfaces to receive adhesives and sealants in accordance with manufacturer's installation instructions.

3.03 INSTALLATION

- A. Install materials in accordance with manufacturer's installation instructions.
- B. Water-Resistive Barriers: Install continuous water-resistive barrier over surfaces indicated, with sheets lapped to shed water but with seams not sealed.
- C. Apply sealants and adhesives within recommended temperature range in accordance with manufacturer's installation instructions.
- D. Mechanically Fastened Exterior Sheets:
 1. Install sheets shingle-fashion to shed water, with seams aligned horizontal.

2. Overlap seams as recommended by manufacturer, 6 inches (152 mm), minimum.
 3. Overlap at outside and inside corners as recommended by manufacturer, 12 inches (305 mm), minimum.
 4. Attach to framed construction with fasteners extending through sheathing into framing, and space fasteners at 12 to 18 inches (305 to 460 mm) on center along each framing member supporting sheathing.
 5. Attach to masonry construction using mechanical fasteners spaced at 12 to 18 inches (305 to 460 mm) vertically on center, and at 24 inches (610 mm), maximum, horizontally on center.
 6. For applications indicated to be airtight, seal seams, laps, penetrations, tears, and cuts with self-adhesive tape; use only large-headed, gasketed fasteners as recommended by manufacturer.
 7. Where stud framing rests on concrete or masonry substrate, extend lower edge of barrier sheets at least 4 inches (102 mm) below bottom of framing and seal to substrate with sealant or approved mounting tape.
 8. Install water-resistive barrier over jamb flashings.
 9. Install head flashings under water-resistive barrier.
 10. At framed openings with frames having nailing flanges, extend sheet into opening and over flanges; at head of opening, seal sheet over flange and flashing.
- E. Coatings:
1. Prepare substrate in accordance with coating manufacturer's installation instructions; treat joints in substrate and between dissimilar materials as indicated.
 2. Apply flashing to seal with adjacent construction and to bridge joints in coating substrate.
- F. Openings and Penetrations in Exterior Water-Resistive Barriers:
1. Install flashing over sills, covering entire sill framing member, and extend at least 5 inches (127 mm) onto water-resistive barrier and at least 6 inches (152 mm) up jambs; mechanically fasten stretched edges.
 2. At openings filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches (100 mm) wide; do not seal sill flange.
 3. At openings filled with nonflanged frames, seal water-resistive barrier to each side of framing at opening using flashing at least 9 inches (230 mm) wide, and covering entire depth of framing.
 4. At head of openings, install flashing under water-resistive barrier extending at least 2 inches (50 mm) beyond face of jambs; seal water-resistive barrier to flashing.
 5. At interior face of openings, seal gaps between window and door frames and rough framing using appropriate joint sealant over backer rod.
 6. Service and Other Penetrations: Form flashing around penetrating items and seal to surface of water-resistive barrier.

3.04 FIELD QUALITY CONTROL

- A. Owner's Inspection and Testing: Cooperate with Owner's testing agency.
1. Allow access to work areas and staging.
 2. Notify Owner's testing agency in writing of schedule for work of this section to allow sufficient time for testing and inspection.
 3. Do not cover work of this section until testing and inspection is accepted.
- B. Do not cover installed water-resistive barriers until required inspections have been completed.
- C. Obtain approval of installation procedures from water-resistive barrier manufacturer based on a mock-up installed in place, prior to proceeding with remainder of installation.
- D. Take digital photographs of each portion of installation prior to covering up weather barriers.

3.05 PROTECTION

- A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION

SECTION 07 42 13.23
METAL COMPOSITE MATERIAL WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Exterior curtain wall system consisting of formed metal composite material (MCM) sheet, framing, secondary supports, and anchors to structure.
- B. Matching flashing and trim.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Installation of anchors.
- B. Section 04 20 00 - Unit Masonry: Installation of anchors.
- C. Section 05 40 00 - Cold-Formed Metal Framing: Panel support framing.
- D. Section 07 25 00 - Weather Barriers: Water-resistive barrier behind wall panel system.
- E. Section 07 62 00 - Sheet Metal Flashing and Trim: Metal flashing components integrated with this wall system.
- F. Section 07 92 00 - Joint Sealants: Sealing joints between siding and adjacent construction and fixtures.

1.03 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2023b.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- E. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2023.
- F. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- H. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- I. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- J. ASTM D1781 - Standard Test Method for Climbing Drum Peel for Adhesives; 1998 (Reapproved 2021).
- K. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics; 2023.
- L. ASTM D4145 - Standard Test Method for Coating Flexibility of Prepainted Sheet; 2010 (Reapproved 2022).
- M. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.

- N. 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.
- O. 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).
- P. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Meeting: Convene one week before starting work of this section to verify project requirements, coordinate with installers of other work, establish condition and completeness of building substrate, and review manufacturers' installation instructions and warranty requirements.
 - 1. Require attendance by the installer and relevant sub-contractors.
 - 2. Include MCM sheet manufacturer's representative and wall system manufacturer's representative to review storage and handling procedures.
 - 3. Review in detail truck transportation, parking, vertical transportation, schedule, personnel, installation of adjacent materials and substrate.
 - 4. Review procedures for protection of work and other construction.
 - 5. Review safety precautions.

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data - MCM Sheets: Manufacturer's data sheets on each product to be used, including thickness, physical characteristics, and finish, and:
 - 1. Finish manufacturer's data sheet showing physical and performance characteristics.
 - 2. Storage and handling requirements and recommendations.
 - 3. Fabrication instructions and recommendations.
 - 4. Specimen warranty for finish, as specified herein.
- C. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
 - 1. Physical characteristics of components shown on shop drawings.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation instructions and recommendations.
 - 4. Specimen warranty for wall system, as specified herein.
- D. Shop Drawings: Show layout and elevations, dimensions and thickness of panels, connections, details and location of joints, sealants and gaskets, method of anchorage, support clips, exposed fasteners, number of anchors, supports, reinforcement, trim, flashings, and accessories.
 - 1. Indicate panel numbering system.
 - 2. Differentiate between shop and field fabrication.
 - 3. Indicate substrates and adjacent work with which the wall system must be coordinated.
 - 4. Include large-scale details of anchorages and connecting elements.
 - 5. Include large-scale details or schematic, exploded or isometric diagrams to fully explain flashing at a scale of not less than 1-1/2 inches per 12 inches (1:10).
 - 6. Include design engineer's stamp or seal on shop drawings for attachments and anchors.
- E. Selection Samples: For each finish product specified, submit at least three sample color chips representing manufacturer's standard range of available colors and patterns.
- F. Verification Samples: For each finish product specified, submit at least three samples, minimum size 12 inch (305 mm) square, and representing actual product in color and texture.
- G. Design Data: Submit structural calculations stamped by design engineer, for Architect's information and project record.

- H. Test Report: Submit report of full-size mock-up tests for air infiltration, water penetration, and wind performance.
- I. Manufacturer's Field Reports: Provide within 48 hours of field review. State what was observed and what changes, if any, were requested or required.
- J. Testing agency's qualification statement.
- K. Maintenance Data: Care of finishes and warranty requirements.

1.06 QUALITY ASSURANCE

- A. Design Engineer's Qualifications: Design structural supports and anchorages under direct supervision of a Structural Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- B. Testing Agency Qualifications: Independent agency experienced in testing assemblies of the type required for this project and having the necessary facilities for full-size mock-up testing of the type specified.

1.07 MOCK-UPS

- A. See Section 01 43 39 - Mockups for requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
 - 1. Protect finishes by applying heavy-duty removable plastic film during production.
 - 2. Package for protection against transportation damage.
 - 3. Provide markings to identify components consistently with drawings.
 - 4. Exercise care in unloading, storing, and installing panels to prevent bending, warping, twisting, and surface damage.
- B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
 - 1. Store in well-ventilated space out of direct sunlight.
 - 2. Protect from moisture and condensation with tarpaulins or other suitable weathertight covering installed to provide ventilation.
 - 3. Store at a slope to ensure positive drainage of accumulated water.
 - 4. Do not store in enclosed space where ambient temperature can exceed 120 degrees F (49 degrees C).
 - 5. Avoid contact with other materials that might cause staining, denting, or other surface damage.

1.09 FIELD CONDITIONS

- A. Do not install panels when air temperature or relative humidity are outside manufacturer's limits.

1.10 WARRANTY

- A. See Section 01 77 00-Closeout Procedures for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Composite Material (MCM) Sheet Manufacturers:
 - 1. ALUCOBOND by 3A Composites USA; ALUCOBOND PLUS: www.alucobondusa.com/#sle.
 - a. Substitutions: not permitted.
 - 2. Coated Metals Group, CMG; System 1000: www.cmgmetals.com.
 - a. Substitutions: See Section 01 60 00-Product Requirements.

2.02 WALL PANEL SYSTEM

- A. Wall Panel System: Metal panels, fasteners, and anchors designed to be supported by framing or other substrate provided by others; provide installed panel system capable of maintaining specified performance without defects, damage, or failure.
 - 1. Provide structural design by or under direct supervision of a Structural Engineer licensed in the State in which the Project is located.
 - 2. Provide panel jointing and weatherseal using a "wet", sealant-sealed system.
 - 3. Anchor panels to supporting framing without exposed fasteners.

2.03 PERFORMANCE REQUIREMENTS

- A. Thermal Movement: Provide for free and noiseless vertical and horizontal thermal movement due to expansion and contraction under material temperature range of minus 20 degrees F (minus 29 degrees C) to 180 degrees F (82 degrees C) without buckling, opening of joints, undue stress on fasteners, or other detrimental effects; allow for ambient temperature at time of fabrication, assembly, and erection procedures.
 - 1. Wind Performance: Provide system tested in accordance with ASTM E330/E330M without permanent deformation or failures of structural members under the following conditions:
 - 2. Inward Design Wind Pressure: as indicated on the Structural Engineer's drawings.
 - 3. Outward Design Wind Pressure: as indicated on the Structural Engineer's drawings.
 - 4. Maximum deflection of perimeter framing member of L/175 normal to plane of the wall; maximum deflection of individual panels of L/60.
 - 5. Maximum anchor deflection in any direction of 1/16 inch (1.6 mm) at connection points of framing members to anchors.
- B. Air Leakage: 0.10 cfm/sq ft (0.50 L/sec sq m) maximum leakage when tested at 1.57 psf (75 Pa) pressure difference in accordance with ASTM E283/E283M.
- C. Water Penetration: No water penetration under static pressure when tested in accordance with ASTM E331 at a differential of 10 percent of inward acting design load, 6.27 psf (300 Pa) minimum, after 15 minutes.
 - 1. Water penetration is defined as the appearance of uncontrolled water on the interior face of the wall.
 - 2. Design to drain leakage and condensation to the exterior face of the wall.
- D. Building Envelope Performance: Comply with ASHRAE Std 90.1 I-P when tested as part of building envelope assembly.

2.04 PANELS

- A. Panels: 1 inch (25.4 mm) deep pans formed of metal composite material sheet by routing back edges of sheet, removing corners, and folding edges.
 - 1. Reinforce corners with riveted aluminum angles.
 - 2. Provide concealed attachment to supporting structure by adhering attachment members to back of panel; attachment members may also function as stiffeners.
 - 3. Maintain maximum panel bow of 0.8 percent of panel dimension in width and length; provide stiffeners of sufficient size and strength to maintain panel flatness without showing local stresses or read-through on panel face.
 - 4. Reinforce panels per manufacturer recommendations with metal angle braces 24 inches (610 mm) on center in short direction.
 - 5. Secure members to back face of panels using structural silicone sealant approved by MCM sheet manufacturer.
 - 6. Metallic Finished Panels: Maintain consistent grain of MCM sheet; specifically, do not rotate sheet purely to avoid waste.
 - 7. Fabricate panels under controlled shop conditions.
 - 8. Where final dimensions cannot be established by field measurement before commencement of manufacturing, make allowance for field adjustments without requiring field fabrication of panels.
-

9. Fabricate as indicated on drawings and as recommended by MCM sheet manufacturer.
 - a. Make panel lines, breaks, curves, and angles sharp and true.
 - b. Keep plane surfaces free from warp or buckle.
 - c. Keep panel surfaces free of scratches or marks caused during fabrication.
10. Provide joint details providing a watertight and structurally sound wall panel system that allows no uncontrolled water penetration on inside face of panel system.

2.05 MATERIALS

- A. Metal Composite Material (MCM) Sheet: Two sheets of aluminum sandwiching a core of extruded thermoplastic material; no foamed insulation material content.
 1. Overall Sheet Thickness: 0.118 inch (3 mm), minimum.
 2. Bond and Peel Strength: No adhesive failure of the bond between the core and the skin nor cohesive failure of the core itself below 22.4 inch-pound/inch (100 N-mm/mm) with no degradation in bond performance, when tested in accordance with ASTM D1781, simulating resistance to panel delamination, after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70 degrees F (21 degrees C).
 3. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 4. Flammability: Self-ignition temperature of 650 degrees F (343 degrees C) or greater when tested in accordance with ASTM D1929.
- B. Metal Framing Members: Include sub-girts, zee-clips, base and sill angles and channels, hat-shaped and rigid channels, and furring channels required for complete installation.
 1. Provide material strength, dimensions, configuration as required to meet applied loads and in compliance with applicable building code.
 2. Sheet Steel Components: ASTM A653/A653M galvanized to G90/Z275 or zinc-iron alloy-coated to A60/ZF180; or ASTM A792/A792M aluminum-zinc coated to AZ60/AZM180.
 3. Stainless Steel Sheet Components: ASTM A480/A480M.
 4. Aluminum Components: ASTM B209/B209M; or ASTM B221 (ASTM B221M).

2.06 FINISHES

- A. Factory Finish: Two coat fluoropolymer resin coating, approved by coating manufacturer for length of warranty specified for project, and applied by coil manufacturing facility that specializes in coil applied finishes.
 1. Coating Flexibility: Pass ASTM D4145 minimum 1T Bend at time of manufacturing.
 2. Long-Term Performance: Not less than that specified under WARRANTY in PART 1.
- B. Fluoropolymer Coil Coating System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, with at least 80 percent of coil coated metal surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch (0.023 mm); color and gloss as selected by Architect from manufacturer's standard line.
 1. Products:
 - a. PPG; Duranar: www.ppgmetalcoatings.com/#sle.
 - b. Sherwin-Williams Company; Fluropon: www.coil.sherwin.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Color/Texture: As indicated on the drawings and selected by Architect from manufacturer's standard range.

2.07 ACCESSORIES

- A. Flashing: Sheet aluminum; 0.040 inch (1.0 mm) thick, minimum; finish and color to match MCM sheet; see Section 07 62 00 for additional requirements.
- B. Joint Sealer: Provide color to match wall panels silicone sealant of type approved by MCM sheet manufacturer, and in compliance with ASTM C920.

- C. Provide panel system manufacturer's and installer's standard corrosion resistant accessories, including fasteners, clips, anchorage devices, and attachments.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine dimensions, tolerances, and interfaces with other work.
- B. Examine substrate on-site to determine that conditions are acceptable for product installation in accordance with manufacturer's written instructions.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- D. Notify Architect in writing of conditions detrimental to proper and timely completion of work, and do not proceed with erection until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Protect adjacent work areas and finish surfaces from damage during installation.
- B. Provide anchorage items to be cast into concrete or built into masonry to appropriate installer(s) together with setting templates.
 - 1. See Section 03 30 00 for additional cast-in-place concrete requirements.
 - 2. See Section 04 20 00 for additional unit masonry requirements.

3.03 INSTALLATION

- A. Do not install products that are defective, including warped, bowed, dented, and broken members, and members with damaged finishes.
- B. Comply with instructions and recommendations of MCM sheet manufacturer and wall system manufacturer, as well as with approved shop drawings.
- C. Install wall system securely allowing for necessary thermal and structural movement; comply with wall system manufacturer's instructions for installation of concealed fasteners.
- D. Do not handle or tool products during erection in manner that damages finish, decreases strength, or results in visual imperfection or failure in performance. Return component parts that require alteration to shop for refabrication, if possible, or for replacement with new parts.
- E. Do not form panels in field unless required by wall system manufacturer and approved by the Architect; comply with MCM sheet manufacturer's instructions and recommendations for field forming.
- F. Separate dissimilar metals; use gasket fasteners, isolation shims, or isolation tape where needed to eliminate possibility of electrolytic action between metals.
- G. Where joints are designed for field-applied sealant, seal joints completely with specified sealant.
- H. Install flashings as indicated on shop drawings. At flashing butt joints, provide a lap strap under flashing and seal lapped surfaces with a full bed of non-hardening sealant.
- I. Install square, plumb, straight, and true, accurately fitted, with tight joints and intersections maintaining the following installation tolerances:
 - 1. Variation From Plane or Location: 1/2 inch in 30 feet (10 mm in 10 m) of length and up to 3/4 inch in 300 feet (20 mm in 100 m), maximum.
 - 2. Deviation of Vertical Member From True Line: 0.1 inch in 25 feet (3 mm in 9 m) run, maximum.
 - 3. Deviation of Horizontal Member From True Line: 0.1 inch in 25 feet (3 mm in 9 m) run, maximum.
 - 4. Offset From True Alignment Between Two Adjacent Members Abutting End To End, In Line: 0.03 inch (0.75 mm), maximum.
- J. Replace damaged products.
 - 1. Exception: Field repairs of minor damage to finishes are permitted only when approved in writing by Architect, panel manufacturer, and fabricator.

2. Field Repairs to Finishes: Using materials and methods sufficient that repairs are not discernible when viewed at distance of 10 feet (3 m) under all typical light conditions experienced at the project.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 45 16-Field Quality Control Procedures for City of Madison requirements.
- B. Wall System Manufacturer's Field Services: Provide field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with instructions.
- C. Site Visits: Schedule two site visits during execution of installation.

3.05 CLEANING

- A. See Section 01 77 00-Closeout Procedures for additional requirements.
- B. Ensure weep holes and drainage channels are unobstructed and free of dirt and sealants.
- C. Remove protective film after installation of joint sealers, after cleaning of adjacent materials, and immediately prior to completion of work.
- D. Remove temporary coverings and protection of adjacent work areas.
- E. Clean installed products in accordance with manufacturer's instructions.

3.06 PROTECTION

- A. Protect installed panel system from damage until Date of Substantial Completion.

END OF SECTION

SECTION 07 42 33
PHENOLIC WALL PANELS - TRESPA

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Exterior solid phenolic cladding panel system and accessories as required for a complete drained and back-ventilated rainscreen system.
- B. Wall panels.
- C. Fascia.
- D. Horizontal soffits.
- E. Storefront panels.
- F. Interior solid phenolic cladding panel system and accessories.

1.02 REFERENCE STANDARDS

- A. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- B. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates; 2023.
- C. ASTM D2247 - Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity; 2015 (Reapproved 2020).
- D. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- E. NFPA 268 - Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source; 2022.
- F. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.

1.03 RELATED SECTIONS

- A. Section 05 50 00 – Metal Fabrications; additional sub-framing, Z-girts to accommodate exterior insulation is not in the scope of Section 07 42 33.
- B. Section 07 20 00 – Insulation; exterior insulation, if required for NFPA 285 compliance, is not included in the scope of Section 07 42 33.
- C. Section 08 41 00 - Entrances and Storefronts.
- D. Section 08 44 12 - Metal Framed Curtain Wall.
- E. Section 09 29 00 - Gypsum Board.

1.04 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM B117-Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - 2. ASTM D635-Standard Test Method for Small Scale Burning.
 - 3. ASTM D1929-Standard Test Method for Ignition Temperature.
 - 4. ASTM D2244-Standards Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
 - 5. ASTM D2247-Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
 - 6. ASTM E84-Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 7. ASTM E 119-Standard Test Method for Fire Rated or Fire Resistive Construction.
 - 8. ASTM E 330-Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors Under the Influence of Wind Loads.
- B. European Standards (EN):

1. EN 438-2-Decorative High Pressure Laminate (HPL) Sheets Based on Thermosetting Resins – Determination of Properties.
 2. EN 12524-Building Materials and Products, Hygrothermal Properties, Tabulated Design Values.
- C. International Organization for Standardization (ISO):
1. ISO 105 A02-93-Tests for Color Fastness-Part A02: Grey scale for assessing change in color.
 2. ISO 178-Determination of Flexural Properties.
 3. ISO 527-3-Determination of Tensile Properties.
 4. ISO 846-Evaluation of the Action of Organisms.
- D. National Fire Protection Association (NFPA):
1. NFPA 268-Standard Test Method for Determining Ignitibility of Exterior Wall Assemblies Using Radiant Heat Energy Source.
 2. NFPA 285-Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Installation methods.
- C. Shop Drawings: Submit plan, section, elevation and perspective drawings necessary to describe and convey the layout, profiles and product components, including edge conditions, panel joints, fixture location, anchorage, accessories, finish colors, patterns and textures
- D. Code Compliance: Documents showing product compliance with local building code shall be submitted prior to the bid. These documents shall include, but not be limited to, appropriate Evaluation Reports and/or test reports supporting the use of the product. Alternate materials must be approved by the Architect of Record prior to the bid date.
- E. Engineering Calculations: Submit engineering calculations as required by the local building code, showing that the installed panels and attachment systems meets the wind load requirements for the project.
- F. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns. Please note that samples are only representative for color and pattern and not for thickness of edge finish. Metallic colors may also show a slight fluctuation in appearance due to the metal flake orientation from batch to batch.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: All primary panel products specified in this section will be supplied by a single manufacturer with a minimum of ten years experience.
- B. Products covered under the Work listed in this section are to be manufactured in an ISO 9001 certified facility.
- C. Installer Qualifications: All products listed in this section are to be installed by a single installer trained and approved by the manufacturer or the representative.
- D. Manufacturer's Field Services: Upon Owner's request, provide manufacturer's field service consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- E. Mock-Up: Provide a mock-up for evaluation of the product and application workmanship.
- F. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
- G. Pre-installation Meetings: Conduct pre-installation conference to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
 - 1. During transportation, use stable, flat pallets that are at least the same dimension as the sheets.
 - 2. Materials shall be packaged to minimize or eliminate the possibility of damage during shipping. Items such as wooden sideboard, wooden lid, and spacers or protective sheeting between panels shall be used to protect the panels from surface or edge damage.
- B. Storage:
 - 1. Store products in an enclosed area protected from direct sunlight, moisture and heat. Maintain a consistent temperature and humidity.
 - 2. Store products in manufacturer's unopened packaging until ready for installation.
 - 3. Stack panels using protective dividers to avoid damage to decorative surface.
 - 4. For horizontal storage, store sheets on pallets of equal or greater size as the sheets with a protective layer between the pallet and sheet and on top of the uppermost sheet.
 - 5. Do not store sheets, or fabricated panels vertically.
- C. Handling:
 - 1. Remove protective film within 24 hours of the panels being removed from the pallet.
 - 2. When moving sheets, lift evenly to avoid dragging panels across each other and scratching the decorative surface.
 - 3. Remove all labels and stickers immediately after installation.

1.08 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Field Measurements: Verify actual measurements/openings by field measurements performed by the installer prior to release for fabrication. Recorded measurements to be indicated on shop drawings based on field measurements provided by the installer. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

1.09 WARRANTY

- A. Warranty: At project closeout, provide manufacturer's limited ten year warranty covering defects in materials. Warranty only available when material installed by an installation contractor trained and approved by the manufacturer's representative.

PART 2 - PRODUCTS**2.01 MANUFACTURER**

- A. Acceptable Manufacturer: Trespa International B.V.
P.O. Box 110, 6000 AC Weert Wetering 20, 6002 SM Weert The Netherlands.
www.trespa.com.
- B. Acceptable Manufacturer's Representative:
Trespa North America, Ltd.; 12267 Crosthwaite Circle, Poway, CA 92064.
ASD Toll Free Tel: (800) 4-TRESPA. Tel: (858) 679-2090.
Fax: (858) 679-9568.
Email: info.northamerica@trespa.com.
Web: <http://www.trespa.com/na>.
- C. Substitutions: Not permitted.

2.02 WALL PANELS

- A. Solid Phenolic Wall Panels: Trespa Meteon by Trespa International as represented by Trespa North America, LTD.

-
1. Material: Solid panel manufactured using a combination of high pressure and temperature to create a flat panel created from thermosetting resins, homogenously reinforced with wood-based fibers and an integrated decorative surface or printed décor.
 2. Color: As selected by the Architect from manufacturer's standard color palette.
 3. Finish: Standard Manufacturer's finish.
 4. Panel Core: Fire retardant (FR) black core.
 5. Panel Thickness: As indicated on the Drawings.
 6. Physical Properties:
 - a. Modulus of Elasticity: 1,300,000 psi (9000 N/mm²) minimum, ISO 178.
 7. Tensile Strength: 10,100 psi (70 N/mm²) minimum, ISO 527-2.
 8. Flexural Strength: 14,500psi (120 N/mm²) minimum, ISO 178.
 9. Thermal Conductivity: 2.1 BTU/inch/ft².hr.°F, EN 12524.
 10. Structural Performance (ASTM E330):
 - a. Panels shall be designed to withstand the Design Wind Load based upon the local building code, but in no case less than 15 pounds per square foot (psf). Wind load testing shall be done in accordance with this standard to obtain the following results:
 - b. Normal to the plane of the wall, the maximum panel deflection shall not exceed L/175.
 - c. Normal to the plane of the wall between supports, deflection of the aluminum sub-framing members shall not exceed L/175 or 3/4-inch, whichever is less.
 - 1) At 1-1/2 times design pressure, permanent deflection of framing members shall not exceed L/100 of span length and components shall not experience failure or gross permanent distortion.
 - 2) If system tests are not available, mock-ups shall be constructed and tests performed under the direction of an independent third party laboratory which show compliance to the minimum standards listed above.
 11. Fire Performance:
 - a. Flame Spread: Class A, ASTM E 84.
 - b. Smoke Development: Less than 450, ASTM E 84.
 - c. Ignition Temperature: Greater than 650 degree F (350 degree C) above ambient, ASTM D1929.
 - d. Burning Classification: CC1 or CC2, ASTM D635.
 - e. When required for compliance with local building codes, the wall cladding assembly shall show no degradation of the rating of Fire Resistant Assemblies, ASTM E119.
 - f. When required for compliance with local building codes, the wall cladding assembly including cladding and non-cladding elements such as, but not limited to, specific weather resistive barriers and/or exterior insulation materials, shall meet the performance requirements of NFPA 285. Performance shall be determined by actual testing in accordance with NFPA 285 or through an equivalency analysis provided by a recognized fire protection expert.
 - g. When required for compliance with local building codes, the wall cladding assembly shall not ignite when exposed to a radiant heat energy source, NFPA 268.
 12. Finish Performance: Electron Beam Cure resin in conformance with the following general requirements:
 - a. Color: As selected by the architect/engineer from manufacturer's standard colors or a custom color to be matched by the panel supplier
 - b. Humidity Resistance: No formation of blisters when subjected to condensing water fog at 100% relative humidity and 100 degree F (38 degree C) for 3000 hours, ASTM D2247.
 - c. Salt Spray Resistance: Corrosion creepage m scribe line (1/16 inch (1.6 mm) max.) and minimum blister rating of 8 within the test specimen field, ASTM B117.
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- d. Weather Exposure: Accelerated - 3000 hours in Atlas Type Weatherometer using cycle of 90 minutes light and 30 minutes diminished light and demineralized water with a maximum color change of 5 Delta E units from the original color according to ASTM D-2244, with the exception of Uni-Colors A12.3.7 / A18.3.5 / A04.1.7, which will not deviate more than 10 Delta E units from original color according to ASTM D-2244.
 - e. Color Stability: The decorative surface shall comply with classification 4-5 measured with the grey scale according to ISO 105 A02-93, according to test method EN 438-2:29.
 - f. Microbial Characteristics: Will not support micro-organic growth (ISO 846).
- B. Mounting System:
- 1. TS210-285-Concealed fastening over fixed depth aluminum sub-framing tested and meeting the performance requirements of NFPA 285.
 - 2. TS3000-285 - Concealed fastening over fixed depth aluminum sub-framing, for plan-style installation, tested and meeting the performance requirements of NFPA 285.
- C. Aluminum Sub Structure: Aluminum sub-structure designed to withstand structural loading due to wind load and the dead load of the panel, painted as required to conceal behind the open joinery of the attachment system.
- 1. Extrusions, including corner closures, joint closures and vent screens, formed members, sheet, and plate shall conform with the recommendations of the manufacturer.
- D. Extruded Aluminum Trim: Color as specified in the finish schedule.
- E. Fasteners (Concealed/Exposed): Fasteners shall be non-corrosive and as recommended by the panel manufacturer. Exposed fasteners shall be colored to match panels where required by the architect.
- F. Panel Corner Profile:
- 1. Dimensions: 142.70 inches (3650mm) by 11.81 inches (300mm) by 11.81 inches (300mm) with a 5/16 inch (8mm) thick by ¾ inch (19mm) radius.
 - 2. Dimensions: 143.70 inches (3650mm) by 11.81 inches (300mm) by 11.81 inches (300mm) with a 3/8 inch (10mm) thick by ¾ inch (19mm) radius.

2.03 ACCESORIES

- A. Joint Closures:
- 1. Size: 2" x 2" (52 mm x 52 mm).
 - 2. Material: Prefinished 26 gauge metal flashing.
 - 3. Color: Black.
 - 4. Angle: To match condition (both 90 degree and non-90 degree angles).
 - 5. Provided by cladding manufacturer and/or installer.

2.04 FABRICATION

- A. Panels: Solid phenolic impregnated kraft paper wall panels with no voids, air spaces or foamed insulation in the core material. Accessory items in accordance with manufacturer's recommendations and approved submittals.
- B. Panel Weight: 8 mm (2.4 lb/ft²), 10 mm (3 lb/ ft²), 13 mm (3.8 lb/ ft²).
- C. Panel Bow: = 2 mm / m (= 0.079 inch/39.38 inches).
- D. Panel Dimensions: Field fabrication shall be allowed where necessary but shall be kept to an absolute minimum. All fabrication shall be done under controlled shop conditions when possible.
- E. Appearance: Panel lines, breaks, and angles shall be sharp, true, and surfaces free from warp and buckle.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.

- B. Surfaces to receive panels shall be even, smooth, dry, and free from defects detrimental to the installation of the panel system. Notify Contract in writing of conditions detrimental to proper and timely completion of the work.
- C. Confirm exterior sheathing is plumb and level, with no deflection greater than 1/4 inch (6mm) in 20 feet (6096mm).
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install solid phenolic wall panels plumb and level and accurately spaced in accordance with manufacturer's recommendations and approved submittals and drawings.
- B. Anchor panels and sub-framing securely per engineering recommendations and in accordance with approved shop drawings to allow for necessary movement and structural support.
- C. Fasten solid phenolic wall panels with fasteners approved for use with supporting substrate.
- D. Do not install panels or component parts which are observed to be defective or damaged including, but not limited to: warped, bowed, abraded, scratched and broken members.
- E. Do not cut or trim component parts during installation in a manner that would damage the finish, decrease the strength, or result in visual imperfection or a failure in performance. Return component parts with the required alteration to the shop for re-fabrication or replacement.
- F. Install corner profiles and trim with fasteners appropriate for use with adjoining construction as indicated on the Contract Drawings and as recommended by manufacturer.

3.04 ADJUSTING AND CLEANING

- A. Remove masking or panel protection as soon as possible after installation. Any masking intentionally left in place after panel installation on an elevation, shall become the responsibility of the General Contractor to remove.
- B. Adjust final panel installation so that all joints are true and even throughout the installation. Panels out of plane shall be adjusted with the surrounding panels to minimize any imperfection.
- C. Repair panels with minor damage. Remove and replace panels damaged beyond repair as a direct result of the panel installation. After installation, panel repair and replacement shall become the responsibility of the General Contractor.
- D. Clean finished surfaces as recommended by panel manufacturer. After installation cleaning, cleaning during construction shall become the responsibility of the General Contractor.

END OF SECTION

**SECTION 07 53 00
ELASTOMERIC MEMBRANE ROOFING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Elastomeric roofing membrane application.
- B. Insulation, flat and tapered.
- C. Vapor retarder.
- D. Deck sheathing.
- E. Cover boards.
- F. Roofing walkway pads.

1.02 RELATED REQUIREMENTS

- A. Section 05 31 00 - Steel Decking: Placement of acoustical insulation for deck flutes.
- B. Section 07 62 00 - Sheet Metal Flashing and Trim.
- C. Section 07 71 00 - Roof Specialties: Prefabricated roofing expansion joint flashing.
- D. Section 07 71 23 - Manufactured Gutters and Downspouts.
- E. Section 07 72 00 Roof Accessories.

1.03 REFERENCE STANDARDS

- A. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
- B. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2023a.
- C. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).
- D. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 2022.
- E. ASTM D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers; 2000 (Reapproved 2020).
- F. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).
- G. ASTM D4637/D4637M - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane; 2015, with Editorial Revision (2022).
- H. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
- I. FM (AG) - FM Approval Guide; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of associated counterflashings installed under other sections.
- B. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all affected installers; review preparation and installation procedures and coordination and scheduling necessary for related work.

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, surfacing, and fasteners.
 - 1. Vapor Retarder: per manufacturer requirements.

- C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, setting plan for tapered insulation, and mechanical fastener layout.
- D. Samples for Verification: Submit two samples of standard size.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Installer's qualification statement.
- G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

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

1.07 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact.
- C. Store materials in weather protected environment, clear of ground and moisture.
- D. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.
- E. Protect foam insulation from direct exposure to sunlight.

1.08 FIELD CONDITIONS

- A. Do not apply roofing membrane during unsuitable weather.
- B. Do not apply roofing membrane when ambient temperature is below 40 degrees F (5 degrees C) or above 100 degrees F (38 degrees C).
- C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
- E. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.09 WARRANTY

- A. See Section 01 77 00-Closeout Procedures for additional warranty requirements.
- B. Correct defective work within a two year period after Date of Substantial Completion.
- C. Provide 30 year manufacturer's material and labor warranty to cover failure to prevent penetration of water.
 - 1. Cover wind speeds up to 72 mph

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. EPDM Membrane Materials:
 - 1. Basis of Design: Elevate/Firestone RubberGuard Max EPDM: www.holcimelevate.com
 - 2. Carlisle SynTec Systems; Sure-Tough EPDM: www.carlisle-syntec.com/#sle.
 - 3. Johns Manville; JM EPDM: www.jm.com/#sle.
 - 4. Versico Roofing Systems; VersiGard EPDM: www.versico.com/#sle.

5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation:
 1. Dow: www.dow.com/#sle.
 2. GAF: www.gaf.com/#sle.
 3. Hunter Panels: www.hunterpanels.com/#sle.
 4. Owens Corning Corporation: www.owenscorning.com/#sle.
 5. ROCKWOOL: www.rockwool.com/#sle.
 6. Versico Roofing Systems; SecurShield Insulation: www.versico.com/#sle.
 7. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ROOFING - UNBALLASTED APPLICATIONS

- A. Elastomeric Membrane Roofing: One ply membrane, fully adhered, over vapor retarder and insulation.
- B. Roofing Assembly Requirements:
 1. Insulation Thermal Resistance (R-Value): 5 per inch, minimum; provide insulation of thickness required.
- C. Acceptable Insulation Types - Constant Thickness Application: Any type that meets requirements and is approved by membrane manufacturer for application.
- D. Acceptable Insulation Types - Tapered Application: Any type that meets requirements and is approved by membrane manufacturer for application.

2.03 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

- A. Membrane: Ethylene-propylene-diene-monomer (EPDM); non-reinforced; complying with minimum properties of ASTM D4637/D4637M.
 1. Thickness: 90 mil, 0.090 inch (2.3 mm), minimum.
 2. Sheet Width: 120 inches (3,048 mm), maximum.
 - a. Adhered Application: Limit width to 120 inches (3,048 mm), maximum, when ambient temperatures are less than 40 degrees F (4.4 degrees C) for extended period of time during installation.
 3. Color: Black.
 4. Tensile Strength: 9 psi (1305 MPa), minimum, measured in accordance with ASTM D412.
 5. Ultimate Elongation: 200 percent, minimum, measured in accordance with ASTM D412.
 6. Durometer Hardness, Type A: 30, minimum, in accordance with ASTM D2240
 7. Tear Strength: 150 lbf per inch (26.3 kN/m), measured in accordance with ASTM D624.
 8. Water Absorption: 8 percent increase in weight, maximum, measured in accordance with ASTM D570, 24 hour immersion.
 9. Water Vapor Permeability: 1 perm inch, measured in accordance with ASTM E96/E96M.
- B. Seaming Materials: As recommended by membrane manufacturer.
- C. Vapor Retarder: (only if required by manufacturer requirements) Non-bituminous, foil and fibrous mesh laminate, complying with requirements of fire rating classification; compatible with roofing and insulation materials.
 1. Fire-retardant adhesive.
 2. Vapor Permeability: 1 perm inch, measured in accordance with ASTM E96/E96M.
- D. Flexible Flashing Material: Same material as membrane.
 1. Thickness: 30 mil (0.76 mm).
 2. Maximum Perm Rate: 0.04.
 3. Tensile Strength: 1,200 psi (8.3 MPa).
 4. Elasticity: 50 percent with full recovery without set.
 5. Color: Black.

2.04 DECK SHEATHING

- A. Deck Sheathing: Glass mat faced gypsum panels, ASTM C1177/C1177M, fire resistant type, 1/4 inch (6.4 mm) thick.
 - 1. Thickness: 5/8 inch (15.9 mm), Type X, fire-resistant.
 - 2. Products:
 - a. Georgia-Pacific; DensDeck: www.densdeck.com/#sle.
 - b. Georgia-Pacific; DensDeck Prime with EONIC Technology: www.densdeck.com/#sle.
 - c. USG Corporation; Securock Ultralight Glass-Mat Roof Board: www.usg.com/#sle.
 - d. USG Corporation; Securock Ultralight Coated Glass-Mat Roof Board: www.usg.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.

2.05 COVER BOARDS

- A. Cover Boards: Glass-mat faced gypsum panels complying with ASTM C1177/C1177M.
 - 1. Thickness: 5/8 inch (15.9 mm), Type X, fire-resistant.
 - 2. FM classified for Very Severe Hail (VSH) in approved single ply membrane assemblies.
 - 3. Products:
 - a. Georgia-Pacific; DensDeck: www.densdeck.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.06 INSULATION

- A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
 - 1. Classifications:
 - a. Type VII: Faced with glass mat faced gypsum board on one major surface of the core foam and faced on the other major surface with any facer described in this specification.
 - 1) Compressive Strength: 16 psi (110 kPa), minimum.
 - 2) Thermal Resistance, R-value (RSI-value): At 1-1/2 inches (38 mm) thick; R-8.5 (1.23) at 75 degrees F (24 degrees C); at total system minimum R-40 must be achieved.
 - 2. Board Size: 48 by 96 inches (1220 by 2440 mm).
 - 3. Board Thickness: 1.5 inch (37.5 mm).
 - 4. Tapered Board: Slope as indicated; minimum thickness as indicated on the drawings; fabricate of fewest layers possible.
 - 5. Board Edges: Square.
 - 6. Products:
 - a. Dow Chemical Company: www.dow.com/#sle.
 - b. GAF; EnergyGuard Polyiso Insulation: www.gaf.com/#sle.
 - c. Mule-Hide Products Co, Inc; Poly ISO Flat: www.mulehide.com/#sle.
 - d. Versico Roofing Systems; SecurShield Insulation: www.versico.com/#sle.

2.07 ACCESSORIES

- A. Prefabricated Roofing Expansion Joint Flashing: See Section 07 71 00.
- B. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; elastomeric material compatible with membrane.
- C. Sheathing Joint Tape: Paper type, 6 inches (152 mm) wide, self adhering.
- D. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches (152 mm) wide; self adhering.
- E. Membrane Adhesive: As recommended by membrane manufacturer.
- F. Thinners and Cleaners: As recommended by adhesive manufacturer, compatible with membrane.
- G. Insulation Adhesive: As recommended by insulation manufacturer.
- H. Roofing Nails: Galvanized, hot-dipped type, size and configuration as required to suit application.

- I. Strip Reglet Devices: Galvanized steel, maximum possible lengths per location, with attachment flanges.
- J. Insulation Perimeter Restraint: Stainless steel edge device configured to restrain insulation boards in position and provide top flashing.
- K. Sealants: As recommended by membrane manufacturer.
- L. Walkway Pads: Suitable for maintenance traffic, contrasting color or otherwise visually distinctive from roof membrane.
 - 1. Composition: 100% Recycled Rubber, non-slip surface.
 - a. With EPDM compatible adhesive strip
 - 2. Size: 30 inches wide, minimum.
 - 3. Thickness: 1/2-inch to 2-inches.
 - 4. Surface Color: Black, Grey or White.
 - 5. Manufacture:
 - a. Same as roofing supplier, if they offer a suitable product.
 - b. RubberForm Recycled Products, LLC.; Rooftop Walkway Rubber Mats;

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and site conditions are ready to receive work.
- B. Verify deck is supported and secure.
- C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
- D. Verify deck surfaces are dry and free of snow or ice.
- E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 PREPARATION - METAL DECK

- A. Install deck sheathing on metal deck.
 - 1. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.
 - 2. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.
 - 3. Tape joints.
- B. Mechanically fasten sheathing to roof deck, in accordance with roofing manufacturer's instructions.
 - 1. Over entire roof area, fasten sheathing using six fasteners with washers per sheathing board.
 - 2. At roof perimeter to a distance of 4 feet (1.2 m) in from edges, fasten sheathing using 6 fasteners with washers per board.

3.03 INSTALLATION - VAPOR RETARDER AND INSULATION, UNDER MEMBRANE

- A. Install vapor retarder to deck surface with adhesive in accordance with manufacturer's instructions.
 - 1. Extend vapor retarder under cant strips and blocking to deck edge.
 - 2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.
- B. Ensure vapor retarder is clean and dry, continuous, and ready for application of insulation.
- C. Attachment of Insulation: Embed insulation in adhesive in full contact, in accordance with roofing and insulation manufacturers' instructions.
- D. Cover Boards: Mechanically fasten cover boards in accordance with roofing manufacturer's instructions and FM (AG) Factory Mutual requirements.
- E. Lay subsequent layers of insulation with joints staggered minimum 6 inches (152 mm) from joints of preceding layer.

- F. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
- G. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.
- H. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
- I. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.
- J. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 18 inches (457 mm).
- K. Do not apply more insulation than can be covered with membrane in same day.

3.04 INSTALLATION - MEMBRANE

- A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
- B. Shingle joints on sloped substrate in direction of drainage.
- C. Fully Adhered Application: Apply adhesive to substrate at rate of ___ gal per 100 sq ft (___ L/9.3 sq m). Fully embed membrane in adhesive except in areas directly over or within 3 inches (76 mm) of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.
- D. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches (76 mm). Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
- E. At intersections with vertical surfaces:
 - 1. Extend membrane over cant strips and up a minimum of 4 inches (102 mm) onto vertical surfaces.
 - 2. Fully adhere flexible flashing over membrane and up to nailing strips.
- F. Around roof penetrations, seal flanges and flashings with flexible flashing.
- G. Install roofing expansion joints where indicated. Make joints watertight.
 - 1. Install prefabricated joint components in accordance with manufacturer's instructions.
- H. Coordinate installation of roof drains and sumps and related flashings.

3.05 FIELD QUALITY CONTROL

- A. See Section 01 45 16-Field Quality Control Procedures for City of Madison requirements. for additional requirements.
- B. Owner will provide testing services, and Contractor to provide temporary construction and materials for testing in accordance with requirements.
- C. Provide daily on-site attendance of roofing and insulation manufacturer's representative during installation of this work.

3.06 CLEANING

- A. See Section 01 77 00-Closeout Procedures for additional requirements.
- B. Remove bituminous markings from finished surfaces.
- C. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.
- D. Repair or replace defaced or damaged finishes caused by work of this section.

3.07 PROTECTION

- A. Protect installed roofing and flashings from construction operations.
- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

**SECTION 07 62 00
SHEET METAL FLASHING AND TRIM**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings and counterflashings.
- B. Sealants for joints within sheet metal fabrications.

1.02 RELATED REQUIREMENTS

- A. Section 07 71 00-Roof Specialties for box scuppers
- B. Section 07 71 23 - Manufactured Gutters and Downspouts.
- C. Section 09 91 13 - Exterior Painting: Field painting of metal surfaces.

1.03 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM B32 - Standard Specification for Solder Metal; 2020.
- D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- F. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- C. Samples: Submit two samples, standard size, illustrating metal finish color.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.
- B. Maintain one copy of each document on site.
- C. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 3 years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- C. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Sheet Metal Flashing and Trim:
 - 1. Petersen Aluminum Corporation: www.pac-clad.com/#sle.

2. Tamlyn; XtremeColor Flashing: www.tamlyn.com/#sle.
3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 SHEET MATERIALS

- A. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge, 0.0239-inch (0.61 mm) thick base metal, shop pre-coated with PVDF coating.
 1. Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
 2. Color: To match approved sample.
- B. Pre-Finished Aluminum: ASTM B209/B209M, 3005 alloy, H12 or H14 temper; 18 gauge, 0.040 inch (1.02 mm) thick; plain finish shop pre-coated with silicone modified polyester coating.
 1. Fluoroethylene Vinyl Ether (FEVE) Coating: Superior performing organic powder coating, AAMA 2605; base coat with clear top coat of FEVE coatings.

2.03 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.
- D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- E. Fabricate corners from one piece with minimum 18-inch (450 mm) long legs; seam for rigidity, seal with sealant.
- F. Fabricate vertical faces with bottom edge formed outward 1/4 inch (6 mm) and hemmed to form drip.
- G. Fabricate flashings to allow toe to extend 2 inches (50 mm) over roofing material. Return and brake edges.

2.04 GUTTERS

- A. See Section 07 71 23 for manufactured gutters and downspouts.

2.05 EXTERIOR PENETRATION FLASHING PANELS

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

2.06 ACCESSORIES

- A. Fasteners: Galvanized steel, with soft neoprene washers.
- B. Underlayment: Polyethylene, 6 mil, 0.006 inch (0.15 mm) thick.
- C. Primer Type: Zinc chromate.
- D. Concealed Sealants: Non-curing butyl sealant.
- E. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
- F. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.
- G. Solder: ASTM B32, Alloy Grade - Sn50 (50/50).

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch (0.38 mm).

3.03 INSTALLATION

- A. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..
- B. Apply plastic cement compound between metal flashings and felt flashings.
- C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- D. Solder metal joints for full metal surface contact, and after soldering wash metal clean with neutralizing solution and rinse with water.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 45 16-Field Quality Control Procedures for City of Madison requirements for field inspection requirements.
- B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION

**SECTION 07 71 00
ROOF SPECIALTIES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Manufactured roof specialties, including copings, fascias, penetration flashings, and box scuppers.
- B. Roof control and expansion joint covers.

1.02 RELATED REQUIREMENTS

- A. Section 07 62 00 - Sheet Metal Flashing and Trim
- B. Section 07 71 23 - Manufactured Gutters and Downspouts
- C. Section 07 72 00 - Roof Accessories: Manufactured curbs, roof hatches, and snow guards.

1.03 REFERENCE STANDARDS

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
- B. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- C. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems; 2022.
- D. 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.
- E. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.
- F. NRCA (RM) - The NRCA Roofing Manual; 2024.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.
- C. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.
- D. Manufacturer's Installation Instructions: Indicate special procedures, fasteners, supporting members, and perimeter conditions requiring special attention.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Roof Edge Flashings and Copings:
 - 1. Architectural Products Co: www.archprod.com/#sle.
 - 2. ATAS International, Inc; Rapid-Lok Fascia: www.atas.com/#sle.
 - 3. Drexel Metals Inc: www.drexmet.com/#sle.
 - 4. Hickman Edge Systems; Formed Coping Plus: www.hickmanedgesystems.com/#sle.
 - 5. Metal-Era Inc; Perma-Tite Coping: www.metalera.com/#sle.
 - 6. Metal Roofing Systems, Inc; Rapid Lock Coping: www.metalroofingsystems.biz/#sle.
 - 7. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Control and Expansion Joint Covers:
 - 1. Construction Specialties, Inc; Roof Covers: www.c-sgroup.com/#sle.
 - 2. EMSEAL Joint Systems, Ltd; Emseal RoofJoint: www.emseal.com/#sle.

3. SITURA Inc; RedLINE Waterproof Expansion Joint Systems: www.situra.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Pipe and Penetration Flashings:
 1. Elmdor: www.elmdor.com/#sle.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Counterflashings:
 1. ATAS International, Inc: www.atas.com/#sle.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Pipe Penetration Wall Seal:
 1. Airex Manufacturing, Inc; Airex Titan Outlet: www.airexmfg.com/#sle.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Expansion Joint Covers Vapor Barriers:
 1. Construction Specialties, Inc; Vapor Barriers: www.c-sgroup.com/#sle.
 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 COMPONENTS

- A. Roof Edge Flashings: Factory fabricated to sizes required; corners mitered; concealed fasteners.
 1. Configuration: Fascia, cant, and edge securement for roof membrane.
 2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test methods RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable local building code.
 3. Exposed Face Height: As indicated on drawings.
 4. Material: Formed steel sheet, galvanized, 24 gauge, 0.024 inch (0.6 mm) thick, minimum.
 5. Finish: 70 percent polyvinylidene fluoride.
 6. Color: As selected by Architect from manufacturer's standard range.
 7. Products:
 - a. Hickman Edge Systems; TerminEdge Fascia: www.hickmanedgesystems.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Copings: Factory fabricated to sizes required; corners mitered; concealed fasteners.
 1. Configuration: Concealed continuous hold down cleat at both legs; internal splice piece at joints of same material, thickness, and finish as cap; concealed stainless steel fasteners.
 2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test method RE-3 to positive and negative design wind pressure as defined by applicable local building code.
 3. Material: Formed steel sheet, galvanized, 24 gauge, 0.024 inch (0.6 mm) thick, minimum.
 4. Finish: Mill finish.
 5. Color: As selected by Architect from manufacturer's standard range.
 6. Products:
 - a. Metal-Era Inc: www.metalera.com/#sle.
 - b. Hickman Edge Systems; Formed Coping Plus: www.hickmanedgesystems.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Control and Expansion Joint Covers: Composite construction of 2-inch (51 mm) wide flexible EPDM flashing of white color with closed cell urethane foam backing, each edge seamed to aluminum sheet metal flanges, designed for nominal joint width of 1 inch (25.4 mm). Include special formed corners, tees, intersections, and wall flashings, each sealed watertight.
- D. Pipe and Penetration Flashing: Base of galvanized steel, compatible with sheet metal roof systems, and capable of accommodating pipes sized between 3/8 inch (9.5 mm) and 12 inches (305 mm).
 1. Caps: EPDM.
 2. Color: As indicated on drawings.
 3. Products:
 - a. Menzies Metal Products; Plumbing Stack Spun Aluminum: www.menzies-metal.com/#sle.

- b. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Roof Penetration Sealing Systems: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.
 - 1. Products:
 - a. Menzies Metal Products; Electrical Roof Stack and Cap: www.menzies-metal.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Counterflashings: Factory fabricated and finished sheet metal that overlaps top edges of base flashing by at least 4 inches (102 mm), and designed to snap into through-wall flashing or reglets with lapped joints.
 - 1. Material: Formed aluminum sheet, 0.025 inch (0.64 mm) thick, minimum.
 - 2. Finish: Mill finish aluminum.
 - 3. Color: As indicated on drawings.
- G. Pipe Penetration Wall Seal: Seal for HVAC piping wall penetrations with wall-mounted rigid plastic outlet cover and elastomeric wall seal gasket.
 - 1. Wall Outlet Size, Siding and Compact Applications: 6-7/8 inches wide by 3-7/8 inches high (175 mm wide by 99 mm high).
 - a. Elastomeric Sleeve Diameter: 1-11/16 inches (43 mm).
 - 2. Outlet Cover Color: Match adjacent cladding material color.
 - 3. Wall Outlet Air Leakage: Comply with ASTM E283/E283M performance tests.
 - 4. Wall Outlet Air Permeance: Comply with ASTM E2178 performance tests.
- H. Box Scupper Drains: Parapet and sidewall applications for roof overflow and drainage.
 - 1. Box Size: 4 inches square x 18 inches long. (Cut to appropriate wall thickness)
 - 2. Flange: Full 4 inches.
 - 3. Outlet Drain Box: 3 inch box with overflow and cleanout to be screw attached to box at building exterior.
 - 4. Fasteners: Stainless Steel
 - 5. Material: Aluminum
 - 6. Finish/Color: As selected by Architect from manufacturer's standard options.
 - 7. Accessories: Strainer Kit; finish to match scupper
 - 8. Products:
 - a. Menzies Metal Products; Clamp-Tite Aluminum Box Scupper Drain: www.menzies-metal.com/#sle.
 - 9. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 FINISHES

- A. Clear Anodized Finish: AAMA 611 AA-M12C22A41 Class I clear anodic coating not less than 0.7 mil, 0.0007 inch (0.018 mm) thick.
- B. Color Anodized Finish: AAMA 611 AA-M12C22A42/44 Class I integrally or electrolytically colored anodic coating not less than 0.7 mil, 0.0007 inch (0.018 mm) thick.
- C. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system; color as indicated.

2.04 ACCESSORIES

- A. Sealant for Joints in Linear Components: As recommended by component manufacturer.
- B. Adhesive for Anchoring to Roof Membrane: Compatible with roof membrane and approved by roof membrane manufacturer.
- C. Insulation Board Adhesive: Two-component, low-rise polyurethane foam adhesive used for adhering insulation to low slope roof deck materials.
 - 1. Products:

- a. OMG Roofing Products; OlyBond500: www.roofing.com/#sle.
- b. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.
 - 1. See Section 07 72 00 for information on roofing related accessories.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.
- B. Seal joints within components when required by component manufacturer.
- C. Anchor components securely.
- D. Coordinate installation of components of this section with installation of roofing membrane and base flashings.
- E. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.

END OF SECTION

SECTION 07 71 23
MANUFACTURED GUTTERS AND DOWNSPOUTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pre-finished aluminum gutters and downspouts.
- B. Pre-finished galvanized steel gutters and downspouts.
- C. Precast concrete splash pads.

1.02 RELATED REQUIREMENTS

- A. Section 07 62 00 - Sheet Metal Flashing and Trim.
- B. Section 07 71 00 - Roof Specialties: Box Scuppers
- C. Section 09 91 13 - Exterior Painting: Field painting of metal surfaces.
- D. Section 22 10 05 - Plumbing Piping: Connection of downspouts to storm sewer.

1.03 REFERENCE STANDARDS

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- D. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Comply with SMACNA (ASMM) for sizing components for rainfall intensity determined by a storm occurrence of 1 in 5 years.
- B. Comply with applicable code for size and method of rain water discharge.
- C. Maintain one copy of each document on site.

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide data on prefabricated components.
- C. Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.
- C. Prevent contact with materials that could cause discoloration, staining, or damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Gutters and Downspouts:
 - 1. Alside, Inc: www.alside.com/#sle.
 - 2. ATAS International, Inc: www.atas.com/#sle.
 - 3. Drexel Metals Inc: www.drexmet.com/#sle.
 - 4. Hickman Edge Systems: www.hickmanedgesystems.com/#sle.

5. SAF Perimeter Systems, a division of Southern Aluminum Finishing Company, Inc:
www.saf.com/persys/#sle.
 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Scupper and Collectors:
1. ATAS International, Inc: www.atas.com/#sle.
 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 MATERIALS

- A. Pre-Finished Galvanized Steel Sheet: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 0.02 inch (0.6 mm) thick base metal.
1. Finish: Shop pre-coated with modified silicone coating.
 2. Color: As indicated.
- B. Pre-Finished Aluminum Sheet: ASTM B209/B209M; 0.032 inch (0.8 mm) thick.
1. Finish: Plain, shop pre-coated with modified silicone coating.
 2. Color: As selected from manufacturer's standard colors.
- C. Protective Backing Paint: Zinc molybdate alkyd.

2.03 COMPONENTS

- A. Gutters: CDA rectangular style profile.
- B. Downspouts: CDA rectangular profile.
- C. Anchors and Supports: Profiled to suit gutters and downspouts.
1. Anchoring Devices: In accordance with CDA requirements.
 2. Gutter Supports: Brackets.
 3. Downspout Supports: Brackets.
- D. Fasteners: Galvanized steel, with soft neoprene washers.

2.04 FABRICATION

- A. Form gutters and downspouts of profiles and size indicated.
- B. Fabricate with required connection pieces.
- C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.
- D. Hem exposed edges of metal.
- E. Fabricate gutter and downspout accessories; seal watertight.

2.05 FINISHES

- A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42, integrally colored anodic coating not less than 0.7 mil, 0.0007 inch (0.018 mm) thick.

2.06 ACCESSORIES

- A. Splash Pads: Precast concrete type, profiles size(s) as indicated; minimum 3,000 psi (21 MPa) compressive strength at 28 days, with minimum 5 percent air entrainment.
- B. Downspout Boots: Smooth interior without boxed corners or choke points; include integral lug slots and on-body cleanout and cover with neoprene gaskets.
1. Configuration: Offset.
 2. Material: PVC.
 3. See Section 22 10 05 - Plumbing Piping for connections to stormwater.
 4. Accessories: Manufacturer's standard rubber coupling and fasteners and wall anchors .

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that surfaces are ready to receive work.

3.02 PREPARATION

- A. Paint concealed sheet metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch (0.381 mm).

3.03 INSTALLATION

- A. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.
- B. Sheet Metal: Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts and accessories.
- C. Slope gutters 1/4 inch per foot (0.5334 mm/m).
- D. Where indicated on drawings, connect downspouts to downspout boots at 8 inches (203.2 mm) above grade. Grout connection watertight.
- E. Set splash pans under downspouts that are not connected to a downspout boot.

END OF SECTION

**SECTION 07 72 00
ROOF ACCESSORIES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Roof curbs.
- B. Insulated Roof hatches.
- C. Snow guards.

1.02 RELATED REQUIREMENTS

- A. Section 07 62 00-Sheet Metal Flashing and Trim.
- B. Section 07 71 00 - Roof Specialties: Other manufactured roof specialty items.

1.03 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; 2023.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Maintenance requirements.
- C. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.
 - 1. Snow Guards: Submit design calculations for loadings and spacings based on manufacturer testing.
- D. Warranty Documentation:
 - 1. Submit manufacturer warranty.
 - 2. Ensure that forms have been completed in Owner's name and registered with manufacturer.
 - 3. Submit documentation that roof accessories are acceptable to roofing manufacturer, and do not limit the roofing warranty.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Store products under cover and elevated above grade.

1.06 WARRANTY

- A. See Section 01 77 00-Closeout Procedures for additional warranty requirements.
- B. Manufacturer Warranty: Provide 5-year manufacturer warranty for parts and labor. Complete forms in Owner's name and register with manufacturer.
- C. Extended Correction Period: Correct defective work within 5-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS**2.01 ROOF CURBS**

- A. Roof Curbs Manufacturers:
 - 1. AES Industries Inc: www.aescurb.com/#sle.
-

2. The Pate Company: www.patecurbs.com/#sle.
 3. LMCurbs; Roof Curbs: www.lmcurbs.com/#sle.
 4. MKT Metal Manufacturing: www.mktduct.com/#sle.
 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Roof Curbs Mounting Assemblies: Factory fabricated hollow sheet metal construction, internally reinforced, and capable of supporting superimposed live and dead loads and designated equipment load with fully mitered and sealed corner joints welded or mechanically fastened, and integral counterflashing with top and edges formed to shed water.
1. Applications: Roof curbs used for roof penetrations/openings as indicated on drawings and HVAC units.
 2. Roof Curb Mounting Substrate: Curb substrate consists of flat roof deck sheathing with insulation.
 3. Sheet Metal Material:
 - a. Galvanized Steel: Hot-dip zinc coated steel sheet complying with ASTM A653/A653M, SS Grade 33 (230); G60 (Z180) coating designation; 18 gauge, 0.048 inch (1.21 mm) thick.
 4. Roofing Cants: Provide integral sheet metal roofing cants dimensioned to begin slope at top of roofing system at 1:1 slope; minimum cant height 4 inches (102 mm).
 5. Provide layouts and configurations indicated on drawings.
- C. Curbs Adjacent to Roof Openings: Provide curb on each side of opening, with top of curb horizontal for equipment mounting.
1. Provide preservative treated wood nailers along top of curb.
 2. Insulate inside curbs with 1-1/2 inch (38 mm) thick fiberglass insulation.
 3. Height Above Finished Roof Surface: 8 inches (203 mm), minimum.

2.02 INSULATED ROOF HATCHES

- A. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf (475 kPa) load.
 2. Hinges: Heavy duty pintle type.
 3. Hold open arm with vinyl-coated handle for manual release.
 4. Latch: Upon closing, engage latch automatically and reset manual release.
 5. Manual Release: Pull handle on interior.
 6. Locking: Padlock hasp on interior.

2.03 SNOW GUARDS

- A. Roof Membrane Fence Type Snow Guards: Base plate attached on top of EPDM, TPO, or PVC roof membrane and anchored to roof deck with mounting bracket that supports flat-faced bar or single tube snow guard.
1. Base Plate: Stainless steel plate with holes for mounting with anchor bolts through membrane to roof deck.
 2. Bracket: Aluminum mounting bracket bolted to base plate.
 3. Products:
 - a. Alpine SnowGuards; PP115 Pipe-Style Snow Guard: www.alpinesnowguards.com/#sle.
 - b. Rocky Mountain Snow Guards, Inc; Single Ply - 2 Pipe or 3 Pipe Bolt Down Snow Fence Bracket: www.rockymountainsnowguards.com/#sle.
 - c. TRA Snow and Sun; Single Ply 1 Deck Mount Snow Fence: www.trasnowandsun.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. See Section 07 71 00 for information on roof specialties.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

3.04 CLEANING

- A. See Section 01 77 00-Closeout Procedures. for additional requirements.
- B. Clean installed work to like-new condition.

3.05 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

**SECTION 07 84 00
FIRESTOPPING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Firestopping systems.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 01 73 29 - Cutting and Patching
- C. Section 07 05 53 - Fire and Smoke Assembly Identification.
- D. Section 09 21 16 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.03 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.
- B. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems; 2020a.
- C. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2020a.
- D. ITS (DIR) - Directory of Listed Products; Current Edition.
- E. FM 4991 - Approval Standard of Firestop Contractors; 2013.
- F. FM (AG) - FM Approval Guide; Current Edition.
- G. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).
- H. UL (DIR) - Online Certifications Directory; Current Edition.
- I. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Sustainable Design Submittal: Submit VOC content documentation for nonpreformed materials.
- E. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- G. Manufacturer's qualification statement.
- H. Installer's qualification statement.

1.05 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
 - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
 - 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

- C. Installer Qualifications: Company specializing in performing the work of this section and:
 - 1. Approved by Factory Mutual Research Corporation under FM 4991, or meeting any two of the following requirements:
 - 2. Verification of minimum three years documented experience installing work of this type.
 - 3. Verification of at least five satisfactorily completed projects of comparable size and type.
 - 4. Licensed by local authorities having jurisdiction (AHJ).

1.06 MOCK-UPS

- A. Install one firestopping assembly representative of each fire rating design required on project.
 - 1. Where one design may be used for different penetrating items or in different wall constructions, install one assembly for each different combination.
 - 2. Where firestopping is intended to fill a linear opening, install at least 1 linear foot (0.305 linear m) of firestopping.
- B. Obtain approval of authorities having jurisdiction (AHJ) before proceeding.
- C. If accepted, mock-up will represent minimum standard for this work.
- D. If accepted, mock-up may remain as part of this work. Remove and replace mock-ups not accepted.

1.07 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Firestopping Manufacturers:
 - 1. 3M Fire Protection Products: www.3m.com/firestop/#sle.
 - 2. A/D Fire Protection Systems Inc: www.adfire.com/#sle.
 - 3. Everkem Diversified Products, Inc; Intumescent Fire-Rated Putty Pads: www.everkemproducts.com/#sle.
 - 4. Fibrex Insulations Inc.; Fluted Deck Pan Firestop Insulation: 1-800-265-7514
 - 5. Grabber Construction Products, Inc; GrabberGard EFC: www.grabberman.com/#sle.
 - 6. Hilti, Inc: www.hilti.com/#sle.
 - 7. HoldRite, a Brand of Reliance Worldwide Corporation; HydroFlame: www.holdrite.com/#sle.
 - 8. Nelson FireStop Products: www.nelsonfirestop.com/#sle.
 - 9. Passive Fire Protection Partners; Firestop 3600EX: www.firestop.com/#sle.
 - 10. Specified Technologies Inc: www.stifirestop.com/#sle.
 - 11. Tremco Commercial Sealants & Waterproofing; TREMstop Acrylic: www.tremcosealants.com/#sle.
 - 12. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 MATERIALS

- A. Firestopping Materials: Any materials meeting requirements.
- B. Prohibited Materials: Do not use hazardous or toxic materials.
- C. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.
- D. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
- E. Fire Ratings: Refer to drawings for required systems and ratings.

2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
 - 1. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
 - 2. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
 - 3. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

2.04 FIRESTOPPING PENETRATIONS THROUGH CONCRETE AND CONCRETE MASONRY CONSTRUCTION

- A. Blank Openings:
 - 1. In Floors or Walls:
 - a. 1 Hour Construction: UL System C-AJ-0090; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 1 Hour Construction: UL System C-AJ-0015; Specified Technologies Inc. SSM Mortar.
 - c. 1 Hour Construction: UL System C-AJ-0116; Specified Technologies Inc. Composite Sheet.
 - d. 1 Hour Construction: UL System C-AJ-0136; Specified Technologies Inc. SSM Mortar.
 - e. 1 Hour Construction: UL System C-AJ-0171; HoldRite HydroFlame 100 Intumescent Firestop Sealant.
- B. Penetrations Through Floors or Walls By:
 - 1. Multiple Penetrations in Large Openings:
 - a. 2 Hour Construction: UL System C-AJ-2863; HoldRite HydroFlame 100 Intumescent Firestop Sealant.
 - b. 2 Hour Construction: UL System C-AJ-8143; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - c. 2 Hour Construction: UL System C-AJ-8114; Specified Technologies Inc. SSM Mortar.
 - 2. Uninsulated Metallic Pipe, Conduit, and Tubing:
 - a. 1 Hour Construction: UL System C-AJ-1039; RectorSeal MetaCaulk 950.
 - 3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
 - a. 2 Hour Construction: UL System C-AJ-2167; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 2 Hour Construction: UL System C-AJ-2772; Specified Technologies Inc. SSW Wrap Strips.
 - 4. Electrical Cables Not In Conduit:
 - a. 2 Hour Construction: UL System C-AJ-3283; Hilti CFS-SL SK Firestop Sleeve Kit.
 - b. 2 Hour Construction: UL System W-J-3199; Hilti CFS-SL SK Firestop Sleeve Kit.
 - 5. Cable Trays with Electrical Cables:
 - a. 2 Hour Construction: UL System C-AJ-4094; Hilti CFS-BL Firestop Block.
 - 6. Insulated Pipes:
 - a. 2 Hour Construction: UL System C-AJ-5091; Hilti FS-ONE IMAX Intumescent Firestop Sealant.
 - b. 2 Hour Construction: UL System C-AJ-5138; Specified Technologies Inc. LCI Intumescent Firestop Sealant.
 - 7. HVAC Ducts, Uninsulated:
 - a. 3 Hour Construction: UL System C-AJ-7204; HoldRite HydroFlame 100 Intumescent Firestop Sealant.
 - b. 2 Hour Construction: UL System C-AJ-7111; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- C. Penetrations Through Walls By:
 - 1. Electrical Cables Not In Conduit:

- a. 2 Hour Construction: UL System C-AJ-3095; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- b. 2 Hour Construction: UL System W-J-3156; Specified Technologies Inc. Ready Split Sleeve.
- c. 2 Hour Construction: UL System W-J-3182; Specified Technologies Inc. Ready Split Sleeve.
- 2. Insulated Pipes:
 - a. 1 Hour Construction: UL System C-AJ-5091; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- 3. HVAC Ducts, Uninsulated:
 - a. 2 Hour Construction: UL System W-J-7109; Hilti FS-ONE MAX Intumescent Firestop Sealant, or CP 606 Flexible Firestop Sealant.
- 4. HVAC Ducts, Insulated:
 - a. 2 Hour Construction: UL System W-J-7112; Hilti FS-ONE MAX Intumescent Firestop Sealant.

2.05 FIRESTOPPING PENETRATIONS THROUGH GYPSUM BOARD WALLS

- A. Blank Openings:
 - 1. 1 Hour Construction: UL System W-L-0020; Specified Technologies Inc. Composite Sheet.
 - 2. 1 Hour Construction: UL System W-L-0038; Specified Technologies Inc. FP Intumescent Firestop Plug.
 - 3. 1 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.
- B. Penetrations By:
 - 1. Multiple Penetrations in Large Openings:
 - a. 1 and 2 Hour Construction: UL System W-L-1568; HoldRite HydroFlame 100 Intumescent Firestop Sealant.
 - b. 1 Hour Construction: UL System W-L-1408; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - c. 1 Hour Construction: UL System W-L-8079; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - 2. Uninsulated Metallic Pipe, Conduit, and Tubing:
 - a. 1 and 2 Hour Construction: UL System W-L-1558; HoldRite HydroFlame 200 Intumescent Firestop Sealant.
 - b. 1 Hour Construction: UL System W-L-1054; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - c. 1 Hour Construction: UL System W-L-1164; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - d. 1 Hour Construction: UL System W-L-1477; Specified Technologies Inc. EZ Firestop Grommet.
 - 3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
 - 4. Electrical Cables Not In Conduit:
 - a. 1 Hour Construction: UL System W-L-3379; Specified Technologies Inc. EZ Firestop Grommet.
 - 5. Cable Trays with Electrical Cables:
 - a. 2 Hour Construction: UL System W-L-4060; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 1 Hour Construction: UL System W-L-4060; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - 6. Insulated Pipes:
 - a. 1 Hour Construction: UL System W-L-5014; Specified Technologies Inc. SSS Intumescent Firestop Sealant.
 - b. 1 Hour Construction: UL System W-L-5029; Hilti FS-ONE Intumescent Firestop Sealant.

- c. 1 Hour Construction: UL System W-L-5121; Specified Technologies Inc. LCI Intumescent Firestop Sealant.
- 7. HVAC Ducts, Insulated:
 - a. 1 Hour Construction: UL System W-L-7156; Hilti FS-ONE MAX Intumescent Firestop Sealant.

2.06 FIRESTOPPING SYSTEMS

- A. Firestopping: Any material meeting requirements.
 - 1. Fire Ratings: See drawings for required systems and ratings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install backing materials to prevent liquid material from leakage.

3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- C. Install labeling required by code.

3.04 FIELD QUALITY CONTROL

- A. Independent Testing Agency: Inspection agency employed and paid by Owner, will examine penetration firestopping in accordance with ASTM E2174 and ASTM E2393.
- B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.05 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.06 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

**SECTION 07 91 00
PREFORMED JOINT SEALS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Precompressed foam seals.
- B. Compression gaskets.
- C. Preformed strip seals.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: Emissions restrictions for joint seal adhesives and primers.
- B. Section 07 92 00 - Joint Sealants: Liquid and mastic joint sealants and their backing materials.
- C. Section 07 95 13 - Expansion Joint Cover Assemblies: for coordination.

1.03 REFERENCE STANDARDS

- A. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber; 2020.
- B. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).
- C. ASTM D2628 - Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements; 1991 (Reapproved 2016).
- D. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures. for submittal procedures.
- B. Product Data: Manufacturer's technical data sheets for each product, including chemical composition, movement capability, color availability, limitations on application, and installation instructions.
- C. Color Cards: For color selection.
- D. Volatile Organic Content (VOC) Documentation: For adhesives and primers, submit VOC content and emissions documentation as specified in Section 01 61 16.
- E. Manufacturer's Qualification Statement.
- F. Installer's Qualification Statement.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 10 years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section with at least 10 years of documented experience.

1.06 WARRANTY

- A. See Section 01 77 00-Closeout Procedures. for additional warranty requirements.
- B. Correct defective work within a two year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealers that fail to achieve watertight seal or exhibit loss of adhesion or cohesion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Precompressed Foam Seals:
 - 1. EMSEAL Joint Systems, Ltd: www.emseal.com/#sle.
 - 2. Nystrom, Inc: www.nystrom.com/#sle.
 - 3. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
 - 4. Watson Bowman Acme Corporation: www.watsonbowmanacme.com/#sle.
 - 5. Willseal LLC: www.willseal.com/#sle.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Preformed Strip Seals:
 - 1. EMSEAL Joint Systems, Ltd: www.emseal.com/#sle.
 - 2. Sika Corporation: www.usa-sika.com/#sle.
 - 3. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
 - 4. Willseal LLC: www.willseal.com/#sle.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PRECOMPRESSED FOAM SEALS

- A. Precompressed Foam Seal: Comprised of urethane, modified-acrylic impregnated, open-cell polyurethane, or closed-cell neoprene foam impregnated with water-repellent, and with self-adhesive faces protected prior to installation by release paper.
 - 1. Color: Black.
 - 2. Size as required to provide weathertight seal when installed.
 - 3. Calculate size according to manufacturer's recommendations.
 - 4. Measure size of existing joints before selecting seal width.
 - 5. Provide product recommended by manufacturer for traffic-bearing use.
 - 6. Applications:
 - a. Exterior wall expansion joints.
 - b. Building facade with seismic constraints.
- B. Precompressed Foam Seal, Fire-Retardant Impregnated: Comprised of waterproof silicone face on fire-retardant impregnated foam seal.
 - 1. Color: Gray.
 - 2. Size as required to provide water-tight seal when installed.
 - 3. Calculate size according to manufacturer's recommendations.
 - 4. Measure size of existing joints before selecting seal width.
 - 5. Provide product recommended by manufacturer for traffic-bearing use.
 - 6. Fire-Rating: As indicated on drawings, comply with UL 2079.
 - 7. Applications:
 - a. Exterior wall expansion joints.
 - b. Building facade with seismic constraints.

2.03 COMPRESSION GASKETS

- A. Compression Gasket: Extruded hollow polychloroprene (neoprene) gasket complying with ASTM D2628; not requiring blockout recess in substrate; not requiring vacuum to collapse seal for installation.
 - 1. Color: Black.
 - 2. Durometer Hardness, Type A: Within 55 to 65, when tested in accordance with ASTM D2240.
 - 3. Size and Shape: As indicated on Drawings.
 - 4. Calculate size in accordance with manufacturer's recommendations.
 - 5. Measure size of existing joints before selecting seal width.
 - 6. Applications:
 - a. Exterior wall expansion joints.

- B. Compression Gasket: Extruded hollow gasket made of closed cell expanded rubber complying with ASTM D1056, with dense surface skin and serrated sidewalls.
 - 1. Color: Black.
 - 2. Durometer Hardness, Type OO: Within 35 to 65, when tested in accordance with ASTM D2240.
 - 3. Calculate size in accordance with manufacturer's recommendations.
 - 4. Measure size of existing joints before selecting seal width.
 - 5. Adhesive: Epoxy sealant/adhesive recommended by gasket manufacturer.
 - 6. Applications:
 - a. Exterior wall expansion joints.

2.04 PREFORMED STRIP SEALS

- A. Preformed Strip Seal: Factory formed profile for adhered application to face of joint substrate.
 - 1. Measure size of existing joints before selecting seal width.
 - 2. Provide compatible materials for application as recommended by manufacturer.
 - 3. Applications:
 - a. Exterior wall expansion joints.
 - b. Door and window perimeter joints.

2.05 ACCESSORIES

- A. Adhesive: As recommended by seal manufacturer.
- B. Substrate Cleaner: Non-corrosive, non-staining type recommended by seal manufacturer; compatible with joint forming materials.
- C. Primer: Type recommended by seal manufacturer to suit application; non-staining.
- D. Backing Tape: Self-adhesive polyethylene tape with surface that seal will not adhere to.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joints are ready to receive this work.
- B. Measure joint dimensions and verify that seal products are of the correct size to properly seal the joints.

3.02 PREPARATION

- A. Properly prepare construction components adjacent to the work of this section to prevent damage and disfigurement due to this work.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's written instructions.
- B. Precompressed Foam Seals:
 - 1. Install only when ambient temperature is within recommended application temperature range of adhesive. Consult manufacturer when installing outside this temperature range.
 - 2. Prepare joints and install seals in accordance with manufacturer's written recommendations.
 - 3. Remove loose materials and foreign matter that could impair adhesion of sealant.
 - 4. Do not stretch precompressed seal; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch (3 to 6 mm) below adjoining surface.
- C. Compression Gaskets:
 - 1. Install only when ambient temperature is within recommended application temperature range of adhesive. Consult manufacturer when installing outside this temperature range.
 - 2. Prepare joints and install seals in accordance with manufacturer's written recommendations.
 - 3. Remove loose materials and foreign matter that could impair adhesion of sealant.
 - 4. Avoid joints except at ends, corners, and intersections; seal joints with adhesive; install with face 1/8 to 1/4 inch (3 to 6 mm) below adjoining surface.

D. Preformed Strip Seals:

1. Install when ambient temperature is within recommended application temperature range of adhesive, and consult with manufacturer before installing outside this temperature range.
2. Prepare joints and install seals in accordance with manufacturer's written recommendations.
3. Remove loose materials and foreign matter that could impair adhesion.
4. When installing over existing non-functioning sealant, remove portions of existing installation that protrude beyond surface; install backing tape on surface of existing sealant installation to prevent adhesion of strip seal.

3.04 CLEANING

- A. Clean adjacent soiled surfaces.

3.05 PROTECTION

- A. Protect joints from damage until adhesives have properly cured.

END OF SECTION

**SECTION 07 92 00
JOINT SEALANTS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Nonsag gunnable joint sealants.
- B. Self-leveling pourable joint sealants.
- C. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: Additional requirements for sealants and primers.

1.03 REFERENCE STANDARDS

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015 (Reapproved 2022).
- B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).
- C. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).
- D. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2020a.
- E. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2022.
- F. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- G. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.
- H. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- I. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.
- J. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019 (Reapproved 2020).
- K. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).
- L. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).
- M. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- N. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).
- O. UL 263 - Standard for Fire Tests of Building Construction and Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures for submittal procedures.
 - B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Backing material recommended by sealant manufacturer.
 - 4. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
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5. Substrates the product should not be used on.
 6. Substrates for which use of primer is required.
 7. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
 8. Sample product warranty.
 9. Certification by manufacturer indicating that product complies with specification requirements.
- C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
- D. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.
- E. Sustainable Design Documentation: For sealants and primers, submit VOC content and emissions documentation; see Section 01 61 16.
- F. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.
- G. Installation Plan: Submit at least four weeks prior to start of installation.
- H. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.
- I. Field Quality Control Plan: Submit at least two weeks prior to start of installation.
- J. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.
- K. Executed warranty.

1.05 QUALITY ASSURANCE

- A. Maintain one copy of each referenced document covering installation requirements on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.
- D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.
- E. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
1. Adhesion Testing: In accordance with ASTM C794.
 2. Compatibility Testing: In accordance with ASTM C1087.
 - a. Provide the associated compatibility matrix to the Architect and Owner.
 3. Allow sufficient time for testing to avoid delaying the work.
 4. Deliver sufficient samples to manufacturer for testing.
 5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
- F. Installation Plan: Include schedule of sealed joints, including the following:
1. Joint width indicated in Contract Documents.
 2. Joint depth indicated in Contract Documents; to face of backing material at centerline of joint.
 3. Method to be used to protect adjacent surfaces from sealant droppings and smears, with acknowledgment that some surfaces cannot be cleaned to like-new condition and therefore prevention is imperative.
 4. Approximate date of installation, for evaluation of thermal movement influence.
 5. Installation Log Form: Include the following data fields, with known information filled out.
 - a. Unique identification of each length or instance of sealant installed.
 - b. Location on project.

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- c. Substrates.
 - d. Sealant used.
 - e. Stated movement capability of sealant.
 - f. Primer to be used, or indicate no primer is used.
 - g. Size and actual backing material used.
 - h. Date of installation.
 - i. Name of installer.
 - j. Actual joint width; provide space to indicate maximum and minimum width.
 - k. Actual joint depth to face of backing material at centerline of joint.
 - l. Air temperature.
- G. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
- 1. Identification of testing agency.
 - 2. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
 - a. Test date.
 - b. Copy of test method documents.
 - c. Age of sealant upon date of testing.
 - d. Test results, modeled after the sample form in the test method document.
 - e. Indicate use of photographic record of test.
- H. Field Quality Control Plan:
- 1. Visual inspection of entire length of sealant joints.
 - 2. Nondestructive field adhesion testing of sealant joints, except interior acrylic latex sealants.
 - 3. Field testing agency's qualifications.
 - 4. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.
- I. Field Adhesion Test Procedures:
- 1. Allow sealants to fully cure as recommended by manufacturer before testing.
 - 2. Have a copy of the test method document available during tests.
 - 3. Take photographs or make video records of each test, with joint identification provided in the photos/videos; for example, provide small erasable whiteboard positioned next to joint.
 - 4. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
 - 5. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
 - 6. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
 - 7. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.
- J. Nondestructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Nondestructive Spot Method.
- 1. Record results on Field Quality Control Log.
 - 2. Repair failed portions of joints.
- K. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
- 1. Sample: At least 18 inches (457 mm) long.
-

2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch (25.4 mm) by that percentage; if adhesion failure occurs before the 1-inch mark is that distance from the substrate, the test has failed.
3. If either adhesive or cohesive failure occurs before minimum elongation, take necessary measures to correct conditions and retest; record each modification to products or installation procedures.

1.06 WARRANTY

- A. See Section 01 77 00-Closeout Procedures for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in Owner's name and register with manufacturer.
- C. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Spray-Applied Sealants:
 1. CertainTeed Corporation: www.certainteed.com/#sle.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Nonsag Sealants:
 1. Dow: www.dow.com/#sle.
 2. Hilti, Inc: www.hilti.com/#sle.
 3. QUIKRETE Companies: www.quikrete.com/#sle.
 4. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
 5. Sika Corporation: www.usa.sika.com/#sle.
 6. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
 7. W.R. Meadows, Inc: www.wrmeadows.com/#sle.
 8. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Self-Leveling Sealants:
 1. Adhesives Technology Corporation: www.atcepoxy.com/#sle.
 2. Bostik Inc: www.bostik-us.com/#sle.
 3. QUIKRETE Companies: www.quikrete.com/#sle.
 4. Sika Corporation: www.usa.sika.com/#sle.
 5. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
 6. W.R. Meadows, Inc: www.wrmeadows.com/#sle.
 7. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 JOINT SEALANT APPLICATIONS

- A. Excluded Scope:
 1. Do Not Seal:
 - a. Intentional weep holes in masonry.
 - b. Joints indicated to be covered with expansion joint cover assemblies.
 - c. Joints where sealant is specified to be furnished and installed by manufacturer of product to be sealed.
 - d. Joints where sealant installation is specified in other sections.
 - e. Joints between suspended ceilings and walls.
- B. Exterior Joints: Use nonsag nonstaining silicone sealant, unless otherwise indicated.
- C. Interior Joints: Use nonsag polyurethane sealant, unless otherwise indicated.

1. Joints between Tile in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
- D. Interior Wet Areas: Bathrooms, restrooms, kitchens, food service areas, and food processing areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

2.03 JOINT SEALANTS - GENERAL

- A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.

2.04 NONSAG JOINT SEALANTS

- A. Nonstaining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
 1. Movement Capability: Plus and minus 25 percent, minimum.
 2. Nonstaining to Porous Stone: Nonstaining to light-colored natural stone when tested in accordance with ASTM C1248.
 3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
- B. Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
 1. Movement Capability: Plus and minus 25 percent, minimum.
 2. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
 3. Color: To be selected by Architect from manufacturer's standard range.
 4. Cure Type: Single component, neutral moisture curing.
 5. Service Temperature Range: Minus 65 to 180 degrees F (Minus 54 to 82 degrees C).
- C. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
 1. Color: as indicated on the drawings.
- D. Polymer Sealant: ASTM C920; single component, cured sealant is paintable and mold/mildew resistant, low odor and VOC, and ultraviolet (UV) resistant.
 1. Color: as indicated on the drawings.
- E. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
 1. Movement Capability: Plus and minus 25 percent, minimum.
- F. Epoxy Sealant: ASTM C881/C881M, Type I and III, Grade 3, Class B and C; two-component.
 1. Hardness Range: 65 to 75, Shore D, when tested in accordance with ASTM C661.
- G. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, nonstaining, nonbleeding, nonsagging; not intended for exterior use.
 1. Color: To be selected by Architect from manufacturer's standard range.
 2. Grade: ASTM C834; Grade 0 Degrees F (Minus 18 Degrees C).
 3. Products:
 - a. Everkem Diversified Products, Inc; EcoTex 25: www.everkemproducts.com/#sle.
 - b. Franklin International, Inc; Titebond Acoustical Smoke & Sound Sealant: www.titebond.com/#sle.
 - c. Hilti, Inc; CP 506 Smoke and Acoustical Sealant: www.us.hilti.com/#sle.
 - d. Pecora Corporation; AC-20 +Silicone: www.pecora.com/#sle.
 - e. Sherwin-Williams Company; White Lightning 3006 Siliconized Acrylic Latex Caulk: www.sherwin-williams.com/#sle.
 - f. Specified Technologies Inc; Smoke N' Sound Acoustical Sealant: www.stifirestop.com/#sle.
 - g. Top Gun, a brand of PPG Architectural Coatings; Top Gun 200: www.ppgpaints.com/#sle.
 - h. Tremco Commercial Sealants & Waterproofing; Tremflex 834: www.tremcosealants.com/#sle.

- i. Tremco Commercial Sealants & Waterproofing; Tremstop Smoke and Sound: www.tremcosealants.com/#sle.
 - j. Tremco Commercial Sealants & Waterproofing; Tremstop Smoke and Sound Spray: www.tremcosealants.com/#sle.
- H. Acrylic Latex Sealant, Water-Based: ASTM C834 Type OP - Opaque and Grade Minus 18 degrees C (0 degrees F); ASTM C920 Class 100/50 for white and colors, and Class 25/25 for clear.
 - 1. Color: To be selected by Architect from manufacturer's standard range.
 - 2. Application Temperature: Within range of 40 to 120 degrees F (4 to 49 degrees C)
 - 3. Service Temperature Range: From 0 to 160 degrees F (minus 18 to 71 degrees C).
 - 4. Products:
 - a. Franklin International, Inc; Titebond DuraMaster Sealant: www.titebond.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- I. Acrylic Latex Sealant: ASTM C834; for use as acoustical sealant and in firestopping systems for expansion joints and through penetrations.
 - 1. Color: To be selected by Architect from manufacturer's standard range.
 - 2. Fire Rated System: Complies with UL 263 and ASTM E119 with UL fire resistance classifications.
 - 3. Products:
 - a. Pecora Corporation; AC-20 FTR (Fire and Temperature Rated): www.pecora.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.05 SELF-LEVELING JOINT SEALANTS

- A. Self-Leveling Silicone Sealant: ASTM C920, Grade P, Uses M and A; single or multicomponent, explicitly approved by manufacturer for traffic exposure when recessed below traffic surface; not expected to withstand continuous water immersion.
 - 1. Movement Capability: Plus 100 percent, minus 50 percent, minimum.
- B. Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multicomponent; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion .
 - 1. Movement Capability: Plus and minus 25 percent, minimum.
- C. Flexible Polyurethane Foam: Single component, gun grade, and low-expanding.
 - 1. Color: as indicated on the drawings.
 - 2. Products:
 - a. Adfast USA Inc; Adfoam Flex 1865: www.adfastcorp.com/#sle.
 - b. DAP Products Inc; DRAFTSTOP 812 Foam: www.dapspecline.com/#sle.
 - c. Tremco Commercial Sealants & Waterproofing; ExoAir LEF: www.tremcosealants.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- D. High Quality Latex-Based Sound Sealant: ASTM C834, Type OP an opaque sealant, and Grade 0, 32 degrees F (0 degrees C), meets requirements for low-temperature flexibility.
 - 1. Color: as indicated on the drawings.
 - 2. Products:
 - a. Everkem Diversified Products, Inc; Sound Seal 90: www.everkemproducts.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.06 ACCESSORIES

- A. Sealant Backing Materials, General: Materials placed in joint before applying sealants; assists sealant performance and service life by developing optimum sealant profile and preventing three-sided adhesion; type and size recommended by sealant manufacturer for compatibility with sealant, substrate, and application.

- B. Preformed Extruded Silicone Joint Seal: Pre-cured low-modulus silicone extrusion, in sizes to fit applications indicated on drawings, combined with a neutral-curing liquid silicone sealant for bonding joint seal to substrates.
 - 1. Size: 1 inch (25.4 mm) wide, in rolls 100 feet (30.5 m) long.
 - 2. Thickness: 0.78 inch (19.8 mm), with ridges along outside bottom edges for bonding area.
 - 3. Color: As selected by Architect..
 - 4. Durometer Hardness, Type A: 26 to 32, minimum, when tested in accordance with ASTM D2240.
 - 5. Tensile Strength: 218 psi (1.5 MPa), in accordance with ASTM D412.
 - 6. Elongation at Break: 554 percent, in accordance with ASTM D412.
 - 7. Products:
 - a. Tremco Commercial Sealants & Waterproofing; Spectrem Simple Seal: www.tremcosealants.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- D. Joint Cleaner: Noncorrosive and nonstaining type, type recommended by sealant manufacturer; compatible with joint forming materials.
- E. Primers: Type recommended by sealant manufacturer to suit application; nonstaining.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.
- D. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
 - 1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
 - 2. Notify Architect of date and time that tests will be performed, at least seven days in advance.
 - 3. Record each test on Preinstallation Adhesion Test Log as indicated.
 - 4. If any sample fails, review products and installation procedures, consult manufacturer, or take other measures that are necessary to ensure adhesion; retest in a different location; if unable to obtain satisfactory adhesion, report to Architect.
 - 5. After completion of tests, remove remaining sample material and prepare joints for new sealant installation.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.
- E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in an inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

- A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Provide joint sealant installations complying with ASTM C1193.
- C. Install acoustical sealant application work in accordance with ASTM C919.

- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- E. Install bond breaker backing tape where backer rod cannot be used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
- I. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 45 16-Field Quality Control Procedures for City of Madison requirements for additional requirements.
- B. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
- C. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet (30 linear m), notify Architect immediately.
- D. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

3.05 POST-OCCUPANCY

- A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width, i.e., at low temperature in thermal cycle. Report failures immediately and repair them.

END OF SECTION

**SECTION 07 95 13
EXPANSION JOINT COVER ASSEMBLIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Expansion joint cover assemblies for wall and ceiling surfaces.

1.02 RELATED REQUIREMENTS

- A. Section 07 91 00 - Preformed Joint Seals: Sealing expansion and control joints using preformed joint seals.
- B. Section 07 92 00 - Joint Sealants: Sealing expansion and control joints using gunnable and pourable sealants.
- C. Section 09 21 16 - Gypsum Board Assemblies: Placement of expansion joint assemblies in gypsum board walls and ceilings.

1.03 REFERENCE STANDARDS

- A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- C. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles; 2020.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Installation Templates: For frames and anchors to be embedded in concrete or masonry, furnish templates to relevant installers; include installation instructions and tolerances.

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices and available colors and finish.
- C. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, affected adjacent construction and anchorage locations.
- D. Samples: Submit two samples of standard lengths, illustrating profile, dimension, color, and finish selected.
- E. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 for additional provisions.
 - 2. Extra Resilient Joint Filler: 15% of installed length and any special tools required for installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Expansion Joint Cover Assemblies:
 - 1. Basis of Design: Inpro: www.inprocorp.com/#sle.
 - 2. Architectural Art Mfg, Inc: www.archart.com/#sle.
 - 3. Construction Specialties, Inc: www.c-sgroup.com/#sle.
 - 4. EMSEAL Joint Systems, Ltd: www.emseal.com/#sle.
 - 5. MM Systems Corp: www.mmsystemscorp.com/#sle.
 - 6. Nystrom, Inc: www.nystrom.com/#sle.
 - 7. Pecora Corporation: www.pecora.com/#sle.
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8. SITURA Inc: www.situra.com/#sle.
9. Watson Bowman Acme Corporation: www.watsonbowmanacme.com/#sle.
10. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 EXPANSION JOINT COVER ASSEMBLY APPLICATIONS

- A. Interior Wall/Ceiling Joints Subject to Thermal Movement:
 1. Manufacturers:
 - a. Balco, Inc; WD Wall and Ceiling Snap-On Joint Cover: www.balcousa.com/#sle.
 - b. Construction Specialties, Inc; Allway Standard Wall and Ceiling Covers: www.c-sgroup.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Exterior Wall Joints Subject to Thermal Movement:
 1. Manufacturers:
 - a. Balco, Inc; Exterior Wall, Elastomeric Face Seal System (FCWW): www.balcousa.com/#sle.
 - b. Construction Specialties, Inc; Exterior Wall Covers: www.c-sgroup.com/#sle.
 - c. EMSEAL Joint Systems, Ltd; BG System: www.emseal.com/#sle.
 - d. SITURA Inc; RedLINE Waterproof Expansion Joint Systems: www.situra.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 EXPANSION JOINT COVER ASSEMBLIES

- A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
 1. Joint Dimensions and Configurations: As indicated on drawings.
 2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
 3. Joint Cover Styles: As indicated on drawings.
 4. Joint Movement Capability: If not indicated, provide minimum plus/minus 25 percent joint movement capability.
 5. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
 6. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.
- B. Sliding Cover Plate Type Covers: Provide plate with beveled edges and neat fit that does not collect dirt.
- C. Covers in Gypsum Board Assemblies: Provide style with anchoring wings that can be completely covered by joint compound.

2.04 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper; or ASTM B308/B308M, 6061 alloy, T6 temper.
 1. Exposed Finish Outdoors: Natural anodized.
 2. Exposed Finish at Floors: Mill finish or natural anodized.
 3. Exposed Finish at Walls and Ceilings: Natural anodized.
- B. Anchors and Fasteners: As recommended by cover manufacturer.
- C. Threaded Fasteners: Galvanized steel.
- D. Backing Paint for Aluminum Components in Contact with Cementitious Materials: Asphaltic type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.

- B. Verify that frames and anchors installed by others are in correct locations and suitable for installation of remainder of assembly.

3.02 INSTALLATION

- A. Install components and accessories in accordance with manufacturer's instructions.
- B. Align work plumb and level.
- C. Rigidly anchor to substrate to prevent misalignment.

3.03 PROTECTION

- A. Do not permit traffic over unprotected floor joint surfaces.
- B. Provide strippable coating to protect finish surface.

END OF SECTION

**SECTION 08 06 71
DOOR HARDWARE SCHEDULE**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preliminary schedule of door hardware sets for swinging, sliding, folding, and other door types as indicated on drawings.

1.02 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware: Requirements to comply with and in coordination with this section.

1.03 REFERENCE STANDARDS

- A. BHMA (CPD) - Certified Products Directory; Current Edition.
- B. BHMA A156.3 - Exit Devices; 2020.
- C. BHMA A156.5 - Cylinders and Input Devices for Locks; 2020.
- D. BHMA A156.13 - Mortise Locks & Latches Series 1000; 2022.
- E. BHMA A156.18 - Materials and Finishes; 2020.
- F. DHI (H&S) - Sequence and Format for the Hardware Schedule; 2019.

1.04 PROJECT INFORMATION

- A. Project Name: Imagination Center at Reindahl Park.
- B. Architect: JLA Architects.
- C. Contractor: To Be Determined.
- D. Hardware Consultant: LaForce | Electronic Security Systems.
Bill Nusbaum, Jr., CSI, CDT
Phone Number: 1-920-490-2351.
Email: bill.nusbaum@laforceinc.com

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Comply with submittal requirements as indicated in Section 08 71 00.

1.06 COORDINATION

- A. Pre-Procurement/Installation Meeting Requirement:
 - 1. After submission of all door/frame/hardware submittals (and related low voltage door hardware submittals), Contractor will organize a meeting(s) with Owner, Architect, General Contractor, Electrician, Door/Frame/Hardware Supplier/Installer, Low-Voltage Supplier/Installer and others as applicable to comprehensively review and explain each door opening's submitted hardware package operation.
 - 2. Procurement of door hardware (and related low voltage components) will NOT occur until this meeting is completed; and until all related submittals are returned by the Owner/Architect team.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Only manufacturers listed in Door Hardware Schedule or Section 08 71 00 are considered acceptable, unless noted otherwise.
 - B. Obtain each type of door hardware as indicated from a single manufacturer and single supplier.
 - C. Products are listed and certified compliant with specified standards by BHMA (CPD).
 - D. Manufacturer's Abbreviations: Coordinate with manufacturers listed in Section 08 71 00.
-

1. ADM - Adams Rite.
2. HGR - Hager.
3. HES - HES.
4. IVE - Ives.
5. KNX - Knox Company.
6. LCN - LCN.
7. McK - McKinney.
8. NGP - National Guard Products.
9. PEM - Pemko.
10. RIX - Rixson.
11. ROC - Rockwood.
12. SAR - Sargent.
13. SCH - Schlage.
14. SEC - Securitron.
15. SDC - Stanley Door Closers.
16. STH - Stanley Commercial Hardware.
17. TR - Trimco.
18. VD - Von Duprin.
19. ZRO - Zero Industries, Inc.

2.02 DESCRIPTION

- A. Door hardware sets provided represent the design intent, they are only a guideline and should not be considered a detailed or complete hardware schedule.
 1. Provide door hardware item(s) as required for similar purposes, even when item is not listed for a door in Door Hardware Schedule.
 2. Necessary items that are not included in a Hardware Set should be added and have the appropriate additional hardware as required for proper application and functionality.
 3. Door hardware supplier is responsible for providing proper size and hand of door for products required in accordance with Door Hardware Schedule and as indicated on drawings.
 4. Quantities listed are for each Pair (PR) of doors, or for each Single (SGL) door, as indicated in hardware sets.

2.03 LOCK FUNCTION CODES

- A. Function Codes for Cylindrical Locks: Complying with BHMA A156.5.
- B. Function Codes for Mortise Locks: Complying with BHMA A156.13.
- C. Function Codes for Exit Devices: Complying with BHMA A156.3.

2.04 FINISHES

- A. Finishes: Complying with BHMA A156.18.
 1. Code 626: Satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D).
 2. Code 630: Satin stainless steel, with stainless steel 300 series base material (former US equivalent US32D).
 3. Code 652: Satin chromium plated over nickel, with steel base material (former US equivalent US26D).

PART 3 EXECUTION

3.01 DOOR HARDWARE SCHEDULE

- A. Organize listing of door hardware components within each hardware set in compliance with 10-Part scheduling sequence indicated in DHI (H&S), unless otherwise indicated. Schedule begins on next page.
- B. Refer to Door and Frame Schedule in the Contract Documents for location of hardware sets.

SET 01

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
	EA	HINGES	BY SECTION 08 71 00	652	HAG
1	EA	PRIVACY SET	49-63-8257; SA190	626	SAR
1	EA	WALL STOP	403	630	ROC

SET 02

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
	EA	HINGES	BY SECTION 08 71 00	652	HAG
1	EA	PRIVACY SET	49-63-8257; SA190	626	SAR
1	EA	CLOSER	351 PS	EN	SAR

SET 03

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
	EA	HINGES	BY SECTION 08 71 00	652	HAG
1	EA	PRIVACY SET	49-8266; SA190	626	SAR
1	EA	ADA OPERATOR	BY SECTION 08 71 13		
2	EA	ACTUATORS	BY SECTION 08 71 13		
1	EA	ELECTRIC STRIKE	1500 DB-2	630	HES
1	EA	WALL STOP	403	630	ROC

SET 04

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
	EA	HINGES	BY SECTION 08 71 00	652	HAG
1	EA	CLASSROOM LOCK	63-10XG37	626	SAR
1	EA	CLOSER	351 H	EN	SAR
1	EA	WALL STOP	403	630	ROC
1	EA	ELECTRIC STRIKE	1500	630	HES
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Presenting credential will open electric strike and allow entry. Door will remain secure upon loss of power. Free egress allowed at all times by inside lever.

SET 04A

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
	EA	HINGES	BY SECTION 08 71 00	652	HAG
1	EA	CLASSROOM LOCK	63-10XG37	626	SAR
1	EA	CLOSER	351 H	EN	SAR
1	EA	OVERHEAD STOP	1-SERIES	630	RIX
1	EA	ELECTRIC STRIKE	1500	630	HES
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Presenting credential will open electric strike and allow entry. Door will remain secure upon loss of power. Free egress allowed at all times by inside lever.

SET 05

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
	EA	HINGES	BY SECTION 08 71 00	652	HAG
1	EA	RIM PANIC	63-8806 ET	630	SAR
1	EA	CLOSER	351 H	EN	SAR
1	EA	WALL STOP	403	630	ROC
1	EA	ELECTRIC STRIKE	9600	630	HES
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Presenting credential will open electric strike and allow entry. Door will remain secure upon loss of power. Free egress allowed at all times by panic device.

SET 06

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
	EA	HINGES	BY SECTION 08 71 00	652	HAG
1	EA	POWER TRANSFER	CEPT	628	SEC
1	EA	SVR PANIC	63-NB8774 ET	630	SAR
1	EA	SVR PANIC	NB8710	630	SAR
1	EA	CLOSER	351 H	EN	SAR
1	EA	CLOSER	351 PSH	EN	SAR
1	EA	WALL STOP	403	630	ROC
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Presenting credential will unlock outside lever and allow entry. Door will remain secure upon loss of power. Free egress allowed at all times by panic device.

SET 07

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
	EA	HINGES	BY SECTION 08 71 00	652	HAG
1	EA	PASSAGE SET	10XU15	626	SAR
1	EA	CLOSER	351	EN	SAR
1	EA	WALL STOP	403	630	ROC
1	EA	KICK PLATE	K1050 34" x 2" LDW	630	ROC

SET 08

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
	EA	HINGES	BY SECTION 08 71 00	652	HAG
1	EA	STOREROOM LOCK	63-10XG04	626	SAR
1	EA	ADA OPERATOR	BY SECTION 08 71 13		
2	EA	ACTUATORS	BY SECTION 08 71 13		
1	EA	OVERHEAD STOP	1-SERIES	630	RIX
1	EA	KICK PLATE	K1050 34" x 2" LDW	630	ROC
1	EA	ELECTRIC STRIKE	1500	630	HES
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Presenting credential will open electric strike and allow entry. Door will remain secure upon loss of power. Free egress allowed at all times by inside lever.

SET 09

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
	EA	HINGES	BY SECTION 08 71 00	652	HAG
1	EA	CLASSROOM LOCK	63-10XG37	626	SAR
1	EA	WALL STOP	403	630	ROC

SET 10

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
	EA	HINGES	BY SECTION 08 71 00	652	HAG
1	EA	PUSH PLATE	70C	630	ROC
1	EA	PULL PLATE	BF111 x 70C	630	ROC
1	EA	CLOSER	351 H	EN	SAR
1	EA	WALL STOP	403	630	ROC

SET 11

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
	EA	HINGES	BY SECTION 08 71 00	652	HAG
1	EA	HOTEL LOCK	49-63-8250; SA190	626	SAR
1	EA	CLOSER	351 H	EN	SAR
1	EA	WALL STOP	403	630	ROC
1	EA	ELECTRIC STRIKE	1500 DB-2	630	HES
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Presenting credential will unlock outside lever and allow entry. When in use, user can throw deadbolt which will not be released by the electric strike. Door will remain secure upon loss of power. Free egress allowed at all times by inside lever.

SET 12

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
	EA	CAM LIFT HINGES	BY DOOR MANUFACTURER		
1	EA	POWER TRANSFER	CEPT	628	SEC
1	EA	FAIL-SECURE LOCK	63-10XG71	626	SCH
1	EA	CLOSER	351 H	EN	SAR
1	EA	WALL STOP	403	630	ROC
1	EA	KICK PLATE	K1050 10" x 2" LDW	630	ROC
1	EA	CARD READER	BY SECURITY CONTRACTOR		
		SOUND SEALS	BY DOOR MANUFACTURER		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Presenting credential will unlock outside lever and allow entry. Doors will remain secure upon loss of power. Free egress allowed at all times by inside lever.

SET 13

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
	EA	HINGES	BY SECTION 08 71 00	652	HAG
2	EA	POWER TRANSFER	CEPT	628	SEC
1	EA	RIM PANIC	LC-56-8806 ET	630	SAR
1	EA	RIM PANIC	56-8810	630	SAR
1	EA	REMOV. MULLION	LC-L980S	USP	SAR
2	EA	CYLINDER	SCHLAGE PRIMUS	626	SCH
1	EA	ADA OPERATOR	BY SECTION 08 71 13		
2	EA	ACTUATORS	BY SECTION 08 71 13		
1	EA	CLOSER	351 PS	EN	SAR
1	SET	SEAL	5050	C	NGP
2	EA	SWEEP	200N	AL	NGP
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Presenting credential will retract latch and allow entry. Door will remain secure upon loss of power. Free egress allowed at all times by panic device.

SET 14

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
	EA	HINGES	BY SECTION 08 71 00	630	HAG
1	EA	STOREROOM LOCK	63-10XG04	626	SAR
1	EA	CLOSER	351 PSH	EN	SAR
1	EA	ELECTRIC STRIKE	6211	630	VON
1	SET	SEAL	160	AL	NGP
1	EA	SWEEP	200N	AL	NGP
1	EA	THRESHOLD	425	AL	NGP
1	EA	RAIN DRIP	16	AL	NGP

OPERATIONAL DESCRIPTION: Door normally closed and locked. Presenting credential will open electric strike and allow entry. Door will remain secure upon loss of power. Free egress allowed at all times by inside lever.

SET 15

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
1	EA	CONTINUOUS HINGE	780-224HD	CLR	HAG
1	EA	POWER TRANSFER	CEPT	628	SEC
1	EA	RIM PANIC	56-63-8804 863	630	SAR
1	EA	ADA OPERATOR	BY SECTION 08 71 13		
2	EA	ACTUATORS	BY SECTION 08 71 13		
1	EA	KICK PLATE	K1050 34" x 2" LDW	630	ROC
1	SET	SEAL	160	AL	NGP
1	EA	SWEEP	200N	AL	NGP
1	EA	THRESHOLD	425	AL	NGP
1	EA	RAIN DRIP	16	AL	NGP
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Presenting credential will retract latch and allow entry. Door will remain secure upon loss of power. Free egress allowed at all times by panic device. ADA Operator to provide external toggle switch on wall at accessible height to turn operator on, off, or to hld open function.

SET 16

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
2	EA	CONTINUOUS HINGE	780-224HD	CLR	HAG
2	EA	POWER TRANSFER	CEPT	628	SEC
1	EA	SVR PANIC	LC-56-63-NB8774 ET	630	SAR
1	EA	SVR PANIC	LC-56-NB8710	630	SAR
1	EA	CYLINDER	SCHLAGE PRIMUS	626	SCH
2	EA	CLOSER	351 H	EN	SAR
2	EA	WALL STOP	403	630	ROC
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Presenting credential will retract latch and allow entry. Door will remain secure upon loss of power. Free egress allowed at all times by panic device.

SET 17

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
	EA	HINGES	BY SECTION 08 71 00	652	HAG
1	EA	PASSAGE SET	ND10	626	SCH
1	EA	WALL STOP	403	630	ROC

SET 18

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
	EA	HINGES	BY SECTION 08 71 00	652	HAG
1	EA	POWER TRANSFER	CEPT	628	SEC
1	EA	FAIL-SECURE LOCK	ND80EULD	626	SCH
1	EA	CYLINDER	SCHLAGE PRIMUS	626	SCH
2	EA	CLOSER	351 H	EN	SAR
2	EA	WALL STOP	403	630	ROC
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Presenting credential will unlock outside lever and allow entry. Door will remain secure upon loss of power. Free egress allowed at all times by inside lever.

SET 19

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
	EA	HINGES	BY SECTION 08 71 00	652	HAG
1	EA	POWER TRANSFER	CEPT	628	SEC
1	EA	FAIL-SECURE LOCK	ND80EULD	626	SCH
1	EA	CYLINDER	SCHLAGE PRIMUS	626	SCH
1	SET	FLUSH BOLT	2962	626	ROC
1	EA	COORDINATOR	2600 x Mtg Brkts	628	ROC
2	EA	CLOSER	351 H	EN	SAR
2	EA	ARMOR PLATE	8400 34" x 1" LDW	630	ROC
2	EA	WALL STOP	403	630	ROC
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Presenting credential will unlock outside lever and allow entry. Door will remain secure upon loss of power. Free egress allowed at all times by inside lever.

SET 20

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
	EA	HINGES	BY SECTION 08 71 00	652	HAG
1	EA	STOREROOM LOCK	ND80LD	626	SCH
1	EA	CYLINDER	SCHLAGE PRIMUS	626	SCH
1	EA	CLOSER	351 H	EN	SAR
1	EA	WALL STOP	403	630	ROC
1	EA	ELECTRIC STRIKE	6211	630	VON
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Presenting credential will open electric strike and allow entry. Door will remain secure upon loss of power. Free egress allowed at all times by inside lever.

SET 21

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
1	EA	CONTINUOUS HINGE	780-224HD	CLR	HAG
1	EA	STOREROOM LOCK	ND80LD	626	SCH
1	EA	CYLINDER	SCHLAGE PRIMUS	626	SCH
1	EA	ADA OPERATOR	BY SECTION 08 71 13		
2	EA	ACTUATOR	BY SECTION 08 71 13		
1	EA	WALL STOP	403	630	ROC
1	EA	ELECTRIC STRIKE	6211	630	VON
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Presenting credential will open electric strike and allow entry. Door will remain secure upon loss of power. Free egress allowed at all times by inside lever.

SET 22

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
1	EA	CONTINUOUS HINGE	780-224HD	CLR	HAG
1	EA	POWER TRANSFER	CEPT	628	SEC
1	EA	RIM PANIC	56-LC-8804 863	630	SAR
1	EA	CYLINDER	SCHLAGE PRIMUS	626	SCH
1	EA	ADA OPERATOR	BY SECTION 08 71 13		
2	EA	ACTUATORS	BY SECTION 08 71 13		
1	SET	SEAL	160	AL	NGP
1	EA	SWEEP	200N	AL	NGP
1	EA	THRESHOLD	425	AL	NGP
1	EA	RAIN DRIP	16	AL	NGP
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Presenting credential will retract latch and allow entry. Door will remain secure upon loss of power. Free egress allowed at all times by panic device.

SET 23

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
ALL HARDWARE BY DOOR MANUFACTURER; SEE SECTION 08 38 00					

SET 24

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
1	EA	CONTINUOUS HINGE	780-224HD	CLR	HAG
1	EA	KEYPAD LOCK	5021R	626	DOR
1	EA	CORE	AS REQUIRED	626	SAR
1	EA	CLOSER	351 H	EN	SAR
1	EA	WALL STOP	403	630	ROC

SET AL1

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
2	EA	CONTINUOUS HINGE	780-112HD	CLR	HAG
2	EA	POWER TRANSFER	CEPT	628	SEC
1	EA	RIM PANIC	56-63-8804 863	630	SAR
1	EA	RIM PANIC	56-LC-8804 863	630	SAR
1	EA	CYLINDER	SCHLAGE PRIMUS	626	SCH
1	EA	REMOV. MULLION	63-L980S	USP	SAR
1	EA	ADA OPERATOR	BY SECTION 08 71 13		
2	EA	ACTUATORS	BY SECTION 08 71 13		
1	EA	CLOSER	351 P10 x DP x BSS	EN	SAR
2	EA	OVERHEAD STOP	1-SERIES	630	RIX
2	EA	SWEEP	200N	AL	NGP
1	EA	THRESHOLD	425	AL	NGP
1	EA	KEY SWITCH	MKA	CLR	SEC
1	EA	CYLINDER	SARGENT I/C	626	SAR
1	EA	CARD READER	BY SECURITY CONTRACTOR		
		SEALS	BY DOOR MANUFACTURER		

OPERATIONAL DESCRIPTION: Doors normally closed and locked. Presenting credential, or using key switch, will retract latches and allow entry. Doors will remain secure upon loss of power. Free egress allowed at all times by panic devices.

SET AL2

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
2	EA	CONTINUOUS HINGE	780-112HD	CLR	HAG
2	EA	PUSH-PULL BAR	BF15847	630	ROC
1	EA	ADA OPERATOR	BY SECTION 08 71 13		
2	EA	ACTUATORS	BY SECTION 08 71 13		
1	EA	CLOSER	351 P10 x DP x BSS	EN	SAR
2	EA	OVERHEAD STOP	1-SERIES	630	RIX
2	EA	SWEEP	200N	AL	NGP
		SEALS	BY DOOR MANUFACTURER		

SET AL3

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
1	EA	CONTINUOUS HINGE	780-112HD	CLR	HAG
1	EA	RIM PANIC	63-8804 863	630	SAR
1	EA	ADA OPERATOR	BY SECTION 08 71 13		
2	EA	ACTUATORS	BY SECTION 08 71 13		
1	EA	ELECTRIC STRIKE	6300	630	VON
1	EA	LOCAL ALARM	EAX-500	GRY	DTX
1	EA	CYLINDER	SARGENT I/C	626	SAR
1	EA	SWEEP	200N	AL	NGP
1	EA	THRESHOLD	425	AL	NGP
1	EA	CARD READER	BY SECURITY CONTRACTOR		
		SEALS	BY DOOR MANUFACTURER		

OPERATIONAL DESCRIPTION: During summer hours, door normally closed and locked. Presenting credential will open electric strike and allow entry. Door will remain secure upon loss of power. Free egress allowed at all times by panic device.

During winter hours, alarm will be active, and only allow egress with alarm. Automatic operator will be manually turned off.

SET AL4

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
1	EA	CONTINUOUS HINGE	780-112HD	CLR	HAG
1	SET	PULLS	BF158-BTB	630	ROC
1	EA	CLOSER	351 H x DP x BSS	EN	SAR
1	EA	WALL STOP	WS401	630	ROC
		SEALS	BY DOOR MANUFACTURER		

SET AL5

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
1	EA	CONTINUOUS HINGE	780-112HD	CLR	HAG
1	SET	PULLS	BF158-BTB	630	ROC
1	EA	DEAD LATCH	4900 x 4560	628	ADM
1	EA	CYLINDER	SARGENT I/C	626	SAR
1	EA	CLOSER	351 H x DP x BSS	EN	SAR
1	EA	WALL STOP	WS401	630	ROC
1	EA	ELECTRIC STRIKE	6211	630	VON
1	EA	CARD READER	BY SECURITY CONTRACTOR		
		SEALS	BY DOOR MANUFACTURER		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Presenting credential will open electric strike and allow entry. Door will remain secure upon loss of power. Free egress allowed at all times by inside lever.

SET AL6

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
1	EA	CONTINUOUS HINGE	780-112HD	CLR	HAG
1	EA	POWER TRANSFER	CEPT	628	SEC
1	EA	RIM PANIC	56-LC-8804 863	630	SAR
1	EA	CYLINDER	SCHLAGE PRIMUS	626	SCH
1	EA	ADA OPERATOR	BY SECTION 08 71 13		
2	EA	ACTUATORS	BY SECTION 08 71 13		
1	EA	OVERHEAD STOP	1-SERIES	630	RIX
1	EA	SWEEP	200N	AL	NGP
1	EA	THRESHOLD	425	AL	NGP
1	EA	CARD READER	BY SECURITY CONTRACTOR		
		SEALS	BY DOOR MANUFACTURER		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Presenting credential will retract latch and allow entry. Doors will remain secure upon loss of power. Free egress allowed at all times by panic device.

SET AL7

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
1	EA	CONTINUOUS HINGE	780-112HD	CLR	HAG
1	EA	POWER TRANSFER	CEPT	628	SEC
1	EA	RIM PANIC	56-63-8804 863	630	SAR
1	EA	REMOV. MULLION	63-L980S	USP	SAR
1	EA	CLOSER	351 P10 x DP x BSS	EN	SAR
1	EA	OVERHEAD STOP	1-SERIES	630	RIX
1	EA	SWEEP	200N	AL	NGP
1	EA	THRESHOLD	425	AL	NGP
1	EA	CARD READER	BY SECURITY CONTRACTOR		
		SEALS	BY DOOR MANUFACTURER		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Presenting credential will retract latch and allow entry. Doors will remain secure upon loss of power. Free egress allowed at all times by panic device.

SET AL8

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
1	EA	CONTINUOUS HINGE	780-112HD	CLR	HAG
1	EA	POWER TRANSFER	CEPT	628	SEC
1	EA	RIM PANIC	56-63-8804 863	630	SAR
1	EA	ADA OPERATOR	BY SECTION 08 71 13		
2	EA	ACTUATORS	BY SECTION 08 71 13		
1	EA	OVERHEAD STOP	1-SERIES	630	RIX
1	EA	SWEEP	200N	AL	NGP
1	EA	THRESHOLD	425	AL	NGP
1	EA	CARD READER	BY SECURITY CONTRACTOR		
		SEALS	BY DOOR MANUFACTURER		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Presenting credential will retract latch and allow entry. Doors will remain secure upon loss of power. Free egress allowed at all times by panic device.

SET AL9

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
1	EA	CONTINUOUS HINGE	780-112HD	CLR	HAG
1	EA	POWER TRANSFER	CEPT	628	SEC
1	EA	RIM PANIC	56-LC-8804 863	630	SAR
1	EA	CYLINDER	SCHLAGE PRIMUS	626	SCH
1	EA	CLOSER	351 P10 x DP x BSS	EN	SAR
1	EA	OVERHEAD STOP	1-SERIES	630	RIX
1	EA	SWEEP	200N	AL	NGP
1	EA	THRESHOLD	425	AL	NGP
1	EA	CARD READER	BY SECURITY CONTRACTOR		
		SEALS	BY DOOR MANUFACTURER		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Presenting credential will retract latch and allow entry. Doors will remain secure upon loss of power. Free egress allowed at all times by panic device.

SET AL10

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
1	EA	CONTINUOUS HINGE	780-112HD	CLR	HAG
1	EA	POWER TRANSFER	CEPT	628	SEC
1	EA	RIM PANIC	56-8810 863	630	SAR
1	EA	CLOSER	351 P10 x DP x BSS	EN	SAR
1	EA	OVERHEAD STOP	1-SERIES	630	RIX
1	EA	SWEEP	200N	AL	NGP
1	EA	THRESHOLD	425	AL	NGP
1	EA	KEY SWITCH	MKA	CLR	SEC
1	EA	CYLINDER	SARGENT I/C	626	SAR
1	EA	CARD READER	BY SECURITY CONTRACTOR		
		SEALS	BY DOOR MANUFACTURER		

OPERATIONAL DESCRIPTION: Doors normally closed and locked. Presenting credential, or using key switch, will retract latches and allow entry. Doors will remain secure upon loss of power. Free egress allowed at all times by panic devices.

SET AL11

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
	EA	HINGE	BY SECTION 08 71 00	652	HAG
2	EA	POWER TRANSFER	CEPT	628	SEC
1	EA	RIM PANIC	56-8810 863	630	SAR
1	EA	RIM PANIC	56-8810	630	SAR
1	EA	REMOVABLE MULLION	63-L980S	USP	SAR
1	EA	ADA OPERATOR	BY SECTION 08 71 13		
2	EA	ACTUATORS	BY SECTION 08 71 13		
1	EA	CLOSER	351 P10 x DP x BSS	EN	SAR
2	EA	OVERHEAD STOP	1-SERIES	630	RIX
2	EA	SWEEP	200N	AL	NGP
1	EA	KEY SWITCH	MKA	CLR	SEC
1	EA	CYLINDER	SARGENT I/C	626	SAR
1	EA	CARD READER	BY SECURITY CONTRACTOR		
		SEALS	BY DOOR MANUFACTURER		

OPERATIONAL DESCRIPTION: Doors normally closed and locked. Presenting credential, or using key switch, will retract latches and allow entry. Doors will remain secure upon loss of power. Free egress allowed at all times by panic devices.

SET AL12

QTY	UNIT	ITEM	DESCRIPTION	FINISH	MFR
	EA	HINGE	BY SECTION 08 71 00	652	HAG
2	EA	POWER TRANSFER	CEPT	628	SEC
1	EA	RIM PANIC	LC-56-8806 ET	630	SAR
1	EA	RIM PANIC	56-8810	630	SAR
1	EA	REMOVABLE MULLION	LC-L980S	USP	SAR
2	EA	CYLINDER	SCHLAGE PRIMUS	626	SCH
1	EA	ADA OPERATOR	BY SECTION 08 71 13		
2	EA	ACTUATORS	BY SECTION 08 71 13		
1	EA	CLOSER	351 P10 x DP x BSS	EN	SAR
2	EA	OVERHEAD STOP	1-SERIES	630	RIX
2	EA	SWEEP	200N	AL	NGP
1	EA	CARD READER	BY SECURITY CONTRACTOR		
		SEALS	BY DOOR MANUFACTURER		

OPERATIONAL DESCRIPTION: Doors normally closed and locked. Presenting credential will retract latch and allow entry. Doors will remain secure upon loss of power. Free egress allowed at all times by panic device.

END OF SECTION

**SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for non-rated wood doors.
- C. Fire-rated hollow metal frames for use with fire rated wood doors.
- D. Thermally insulated hollow metal doors with frames.
- E. Hollow metal borrowed lites glazing frames.
- F. Accessories, including glazing, louvers, and matching panels.

1.02 RELATED REQUIREMENTS

- A. Section 08 14 16 - Flush Wood Doors.
- B. Section 08 34 73 - Sound Control Door Assemblies.
- C. Section 08 71 00 - Door Hardware.
- D. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.
- E. Section 09 91 13 - Exterior Painting: Field painting.
- F. Section 09 91 23 - Interior Painting: Field painting.

1.03 ABBREVIATIONS AND ACRONYMS

- A. ANSI: American National Standards Institute.
- B. HMMA: Hollow Metal Manufacturers Association.
- C. NAAMM: National Association of Architectural Metal Manufacturers.
- D. NFPA: National Fire Protection Association.

1.04 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2022.
- C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.
- D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023.
- G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- H. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.
- I. ASTM C476 - Standard Specification for Grout for Masonry; 2023.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.
- K. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.

- L. ICC A117.1-2009 - Accessible and Usable Buildings and Facilities; 2009.
- M. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- N. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- O. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2017.
- P. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.
- Q. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2023.

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
- D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- E. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
- F. Manufacturer's Qualification Statement.
- G. Installer's Qualification Statement.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- C. Maintain at project site copies of reference standards relating to installation of products specified.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
 - 1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 2. Curries, an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 3. Fleming Door Products, an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 4. Krieger Specialty Products: www.kriegerproducts.com/#sle.
 - 5. Mesker, dormakaba Group; FDJ Series Drywall Frames: www.meskeropeningsgroup.com/#sle.
 - 6. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
 - 7. Steelcraft, an Allegion brand: www.allegion.com/#sle.
 - 8. Technical Glass Products; SteelBuilt Window & Door Systems: www.tgpamerica.com/#sle.
 - 9. Titan Metal Products, Inc; Builders Series 20 - 90 Minute Doors: www.titanmetalproducts.com/#sle.
 - 10. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Requirements for Hollow Metal Doors and Frames:
 - 1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
 - 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
 - 3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
 - 4. Door Edge Profile: Manufacturers standard for application indicated.
 - 5. Typical Door Face Sheets: Flush.
 - 6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.
 - 7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

- A. Exterior Doors: Thermally insulated.
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 2 - Heavy-duty.
 - b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
 - 2. Door Core Material: Polystyrene, 1 lbs/cu ft minimum density.
 - a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
 - 3. Door Thermal Resistance: R-Value of 6.0 minimum, for installed thickness of polystyrene.
 - 4. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
 - 5. Door Face Sheets: Flush.
 - 6. Weatherstripping: Refer to Section 08 71 00.
 - 7. Door Finish: Factory primed and field finished.
- B. Interior Doors, Non-Fire-Rated:
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 2 - Heavy-duty.
 - b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
 - 2. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
 - 3. Door Finish: Factory primed and field finished.

2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
 - B. Frame Finish: Factory primed and field finished.
 - C. Exterior Door Frames: Full profile/continuously welded type.
-

1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
 2. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
 3. Weatherstripping: Separate, see Section 08 71 00.
- D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
1. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch (150 mm), maximum, above floor at 45 degree angle.
 2. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
- E. Door Frames, Fire-Rated: Full profile/continuously welded type.
1. Fire Rating: Same as door, labeled.
 2. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch (150 mm), maximum, above floor at 45 degree angle.
 3. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
- F. Borrowed Lites Glazing Frames:
1. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
 2. Construction and face dimensions to match door frames, and as indicated on drawings.
- G. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
- H. Mullions for Pairs of Doors: Fixed, except where removable is indicated, with profile similar to jambs.
- I. Transom Bars: Fixed, of profile same as jamb and head.
- J. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
- K. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches (102 mm) high to fill opening without cutting masonry units.
- L. Frames Wider than 48 inches (1219 mm): Reinforce with steel channel fitted tightly into frame head, flush with top.

2.05 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 ACCESSORIES

- A. Door Window Frames: Door window frames with glazing securely fastened within door opening.
1. Size: As indicated on drawings.
 2. Frame Material: 18 gauge, 0.0478 inch (1.21 mm), galvanized steel.
 3. Metal Finish: as indicated on the drawings with polyester powder coating.
 4. Glazing: 1/4 inch (6.4 mm) thick, tempered glass, in compliance with requirements of authorities having jurisdiction.
 5. Manufacturers:
 - a. All Metal Stamping: www.allmetalstamping.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Glazing: As specified in Section 08 80 00, factory installed.
- C. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.
- D. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.
1. Manufacturers:
 - a. ITW Commercial Construction North America; ITW CCNA-Buildex Tek's Select Series: www.ITWBuildex.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

- E. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches (102 mm) as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.
- F. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- G. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Coordinate frame anchor placement with wall construction.
- C. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- D. Install door hardware as specified in Section 08 71 00.
- E. Comply with glazing installation requirements of Section 08 80 00.
- F. Coordinate installation of electrical connections to electrical hardware items.
- G. Touch up damaged factory finishes.

3.04 TOLERANCES

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
- B. Maximum Diagonal Distortion: 1/16 inch (1.6 mm) measured with straight edge, corner to corner.

3.05 ADJUSTING

- A. Adjust for smooth and balanced door movement.
- B. Test sound control doors for force to close, latch, and unlatch; adjust as necessary in compliance with requirements.

3.06 SCHEDULE

- A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

**SECTION 08 14 16
FLUSH WOOD DOORS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flush wood doors; flush partial-glazed configuration; fire-rated and non-rated.

1.02 RELATED REQUIREMENTS

- A. Section 08 11 13 - Hollow Metal Doors and Frames.
- B. Section 08 71 00 - Door Hardware.
- C. Section 08 80 00 - Glazing.

1.03 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- D. AWMAC (GIS) - Guarantee and Inspection Services Program; Current Edition.
- E. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- F. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- G. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.
- H. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- I. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.
- J. WI (CCP) - Certified Compliance Program (CCP); Current Edition.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
 - 1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
- D. Samples: Submit two samples of door veneer standard size illustrating wood grain, stain color, and sheen.
- E. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- F. Manufacturer's Installation Instructions: Indicate special installation instructions.
- G. Manufacturer's qualification statement.
- H. Installer's qualification statement.
- I. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

- A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.

1. Company with at least one project within past five years with value of woodwork within at least 20 percent of cost of woodwork for this project.
 2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- C. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
- D. Woodwork Quality Assurance Program:
1. Comply with AWMAC (GIS) woodwork association quality assurance service/program in accordance with requirements for work specified in this section.
 2. Comply with WI (CCP) woodwork association quality assurance service/program in accordance with requirements for work specified in this section; www.woodworkinstitute.com/#sle.
 3. Provide labels indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
 4. Provide designated labels on shop drawings as required by quality assurance program.
 5. Provide designated labels on installed products as required by quality assurance program.
 6. Submit documentation upon completion of installation that verifies this work is in compliance with specified requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging, and inspect for damage.
- C. Protect doors with resilient packaging; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges if stored more than one week, and break seal on site to permit ventilation.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for 2 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Wood Veneer Faced Doors:
1. Basis of Design: Masonite Architectural; Aspiro Select Wood Veneer Doors: www.architectural.masonite.com/#sle.
 2. Haley Brothers: www.haleybros.com/#sle.
 3. Krieger Specialty Products: www.kriegerproducts.com/#sle.
 4. Oregon Door: www.oregondoor.com/#sle.
 5. VT Industries, Inc: www.vtindustries.com/#sle.
 6. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 DOORS AND PANELS

- A. Doors: See drawings for locations and additional requirements.
- B. Interior Doors: 1-3/4 inches (44 mm) thick unless otherwise indicated; flush construction.
 1. Provide solid core doors at each location.
 2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
 3. Smoke and Draft Control Doors: In addition to required fire rating, provide door assemblies tested in accordance with UL 1784 with maximum air leakage of 3.0 cfm per sq ft (0.01524 cu m/s/sq m) of door opening at 0.10 inch wg (24.9 Pa) pressure at both ambient and elevated temperatures for "S" label; if necessary, provide additional gasketing or edge sealing.

2.03 DOOR AND PANEL CORES

- A. Non-Rated Solid Core, plies and faces as indicated.
- B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.04 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: White oak, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
 - 1. Vertical Edges: Any option allowed by quality standard for grade.
 - 2. "Running Match" each pair of doors and doors in close proximity to each other.

2.05 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
 - 1. Provide solid blocks at lock edge for hardware reinforcement.
 - 2. Provide solid blocking for other throughbolted hardware.
- C. Where supplementary protective edge trim is required, install trim after veneer facing has been applied full-width.
- D. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
- E. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- F. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- G. Provide edge clearances in accordance with the quality standard specified.

2.06 FINISHES - WOOD VENEER DOORS

- A. Factory finish doors in accordance with approved sample.
 - 1. Basis of Design: Aspiro Series Nutmeg on White Oak
- B. Seal door top edge with color sealer to match door facing.

2.07 ACCESSORIES

- A. Hollow Metal Door Frames: See Section 08 11 13.
- B. Glazed Openings:
 - 1. Heat-Strengthened and Fully Tempered Glass: ASTM C1048.
 - 2. Laminated Safety Glass: Comply with 16 CFR 1201 test requirements for Category II.
 - 3. Glazing: See Section 08 80 00 - Glazing.
 - 4. Tint: Clear.
- C. Door Window Frames: Door window frames with glazing securely fastened within door opening.
 - 1. Size: As indicated on drawings.
 - 2. Glazing: See Section 08 80 00 - Glazing.
 - 3. Manufacturers:
 - a. All Metal Stamping: www.allmetalstamping.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Glazing Accessories: See Section 08 80 00 - Glazing.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
 - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
 - 2. Install smoke and draft control doors in accordance with NFPA 105 requirements.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.
- E. Coordinate installation of glazing.

3.03 TOLERANCES

- A. Comply with specified quality standard for fit and clearance tolerances.
- B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

3.05 SCHEDULE

- A. See Door and Frame schedule on drawings.

END OF SECTION

**SECTION 08 31 00
ACCESS DOORS AND PANELS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall- and ceiling-mounted access units.

1.02 RELATED REQUIREMENTS

- A. Section 09 91 23 - Interior Painting: Field paint finish.
- B. Section 23 33 00 - Air Duct Accessories: Access doors in ductwork.

1.03 REFERENCE STANDARDS

- A. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Shop Drawings: Indicate exact position of each access door and/or panel unit.
- D. Manufacturer's Installation Instructions: Indicate installation requirements.
- E. Manufacturer's qualification statement.
- F. Project Record Documents: Record actual locations of each access unit.

1.05 QUALITY ASSURANCE

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

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS ASSEMBLIES

- A. Wall-Mounted Units in Wet Areas:
 - 1. Panel Material: Steel, hot-dipped zinc, or zinc-aluminum-alloy coated.
 - 2. Size: 12 by 12 inches (305 by 305 mm).
 - 3. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.
 - 4. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.
 - 5. Plaster Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.
- B. Fire-Rated Wall-Mounted Units:
 - 1. Wall Fire-Rating: As indicated on drawings.
 - 2. Panel Material: Steel.
 - 3. Size: 12 by 12 inches (305 by 305 mm).
 - 4. Door/Panel: Insulated double-surface panel, with tool-operated spring or cam lock and no handle.
- C. Fire-Rated Ceiling-Mounted Units:
 - 1. Ceiling Fire-Rating: As indicated on drawings.
 - 2. Panel Material: Steel.
 - 3. Size: 12 by 12 inches (305 by 305 mm).
 - 4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.

2.02 WALL- AND CEILING-MOUNTED ACCESS UNITS

- A. Manufacturers:
-

1. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com/#sle.
 2. ACUDOR Products Inc: www.acudor.com/#sle.
 3. Babcock-Davis: www.babcockdavis.com/#sle.
 4. Best Access Doors: www.bestaccessdoors.com/#sle.
 5. Cendrex, Inc: www.cendrex.com/#sle.
 6. Elmdor: www.elmdor.com/#sle.
 7. FF Systems, Inc: www.ffsystemsinc.com/#sle.
 8. Karp Associates, Inc: www.karpinc.com/#sle.
 9. MIFAB, Inc; UA Series: www.mifab.com/#sle.
 10. Nystrom, Inc; HVAC - Access Doors: www.nystrom.com/#sle.
 11. Studco Building Systems; EZConcept AccessDor : www.studcosystems.com/#sle.
 12. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Wall- and Ceiling-Mounted Units: Factory-fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
1. Style: Exposed frame with door surface flush with frame surface.
 - a. Gypsum Board Mounting Criteria: Use drywall bead type frame.
 - b. Plaster Mounting Criteria: Use plaster bead type frame.
 2. Door Style: Single thickness with rolled or turned in edges.
 3. Frames: 16-gauge, 0.0598-inch (1.52 mm) minimum thickness.
 4. Heavy-Duty Frames: 14-gauge, 0.0747-inch (1.89 mm) minimum thickness.
 5. Single Steel Sheet Door Panels: 16-gauge, 0.0625-inch (1.6 mm) minimum thickness.
 6. Heavy-Duty Single Steel Sheet Door Panels: 14-gauge, 0.0747-inch (1.89 mm) minimum thickness.
 7. Insulation: Non-combustible mineral wool or glass fiber.
 8. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
 - a. Provide products listed by UL (FRD) as suitable for purpose indicated.
 9. Steel Finish: Primed.
 10. Primed and Factory Finish: Polyester powder coat; color as indicated on the drawings.
 11. Door/Panel Size: As indicated on the drawings.
 12. Hardware:
 - a. Hardware for Fire-Rated Units: As required for listing.
 - b. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
 - c. Handle: Handle operated cam latch.
 - d. Latch/Lock: Tamperproof tool-operated cam latch.
 - e. Inside Latch Release: Mechanism that allows door/panel to be opened from inside.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings are correctly sized and located.
- B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to proceeding with this work.
- B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.

- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION

SECTION 08 34 73
SOUND CONTROL DOOR ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sound control door assemblies.
 - 1. Metal doors and frames.
 - 2. Thermally insulated exterior door and frames.

1.02 RELATED REQUIREMENTS

- A. Section 07 21 19 - Foamed-in-place insulation.
- B. Section 08 71 00 - Door Hardware.
- C. Section 09 91 23 - Interior Painting: Field painting.

1.03 ABBREVIATIONS AND ACRONYMS

1.04 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames; 2019.
- C. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2022.
- D. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2020.
- E. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.
- F. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.
- G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- H. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023.
- I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- J. ASTM E336 - Standard Test Method for Measurement of Airborne Sound Attenuation Between Rooms in Buildings; 2023.
- K. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
- L. ASTM E413 - Classification for Rating Sound Insulation; 2022.
- M. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.
- N. ICC A117.1-2009 - Accessible and Usable Buildings and Facilities; 2009.
- O. NAAMM HMMA 805 - Recommended Selection and Usage Guide for Hollow Metal Doors and Frames; 2012.
- P. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- Q. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- R. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2017.

- S. NAAMM HMMA 850 - Fire-Rated Hollow Metal Doors and Frames; 2014.
- T. NAAMM HMMA 865 - Guide Specifications for Sound Control Hollow Metal Door and Frame Assemblies; 2013.
- U. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- V. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2023.
- W. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, anchorage, hardware reinforcement, any indicated finish requirements and interface of the work of this section with the work of adjacent trades.
- D. Submit a schedule of items to be provided under this section.
- E. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- F. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
- G. Manufacturer's Qualification Statement.
- H. Manufacturer's Warranty - Upon completion of the work of this Section, provide the Architect with two (2) copies of the manufacturer's standard written five (5) year warranty made out to the Owner..

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.
- C. Testing Agency Qualifications: Independent testing agency accredited as an acoustical laboratory and certified to perform specified field testing.
- D. Maintain at project site copies of reference standards relating to installation of products specified.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect metal doors in compliance with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) and specified requirements.
 - 1. Temporary Frame Spreaders: Provide welded frame jamb spreaders to bottom of metal frame prior to shipping.
- B. Remove doors and frames from resilient packaging upon delivery on site and inspect for damage. All discrepancies, deficiencies and/or damages shall be immediately reported to the supplier in writing.
- C. Store all materials on planks or dunnage on a dry location. Provide cover over doors for protection until installed, and store in vertical position properly braced with blocking to permit air circulation between components.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Sound Control Door Assemblies:
 - 1. BASIS OF DESIGN: Overly Door Company: www.overly.com/#sle.

- a. Model Number: 509575
- 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 REGULATORY REQUIREMENTS

- A. Accessibility: Comply with ICC A117.1 and ADA Standards.
- B. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with specified requirements for each type; for instance, a sound control door is also indicated as being an exterior door must comply with requirements specified for sound control doors and exterior doors; where two requirements conflict, comply with most stringent.

2.03 COMPONENTS

- A. Door Edge Profile: Manufacturer's standard for application indicated.

2.04 SOUND CONTROL DOORS

- A. Metal Sound Control Interior Doors:
 - 1. Metal Doors: Refer to drawings for locations and additional requirements.
 - a. Based on NAAMM HMMA Custom Guidelines:
 - 1) Comply with guidelines of NAAMM HMMA 865 for sound control metal doors and frames.
 - 2) Performance Level 2 - Moderate Duty, in accordance with NAAMM HMMA 805.
 - 3) Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
 - 4) Door Face Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
 - 5) Comply with guidelines of NAAMM HMMA 850 for fire-rated doors.
 - b. Steel Sheet: Comply with one or more of the following requirements; cold-rolled steel complying with ASTM A366 or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
 - 2. Sound Transmission Class (STC) Rating of Sound Control Door Assembly: STC of 50, minimum, calculated in accordance with ASTM E413, and tested in accordance with ASTM E90.
 - 3. Door Thickness: As required to comply with sound control requirements as indicated.
 - 4. Door Face Sheets: Flush.
 - 5. Door Finish: Factory primed and field finished.
 - 6. Sound Seals: As required by manufacturer to meet indicated sound control ratings.
 - 7. Exterior Doors, Thermally Insulated:
 - a. Door Core Material: Manufacturers standard core material and construction to comply with sound control requirements as indicated.
 - 8. Hardware Reinforcement: Factory mortise, reinforce, drill and tap and doors and frames for all mortise hardware as required by hardware manufacturer's template. Provide necessary reinforcement plates as required for surface mounted hardware; all drilling and tapping to be done in field by installer. Provide dust cover boxes on all frame mortises.

2.05 SOUND CONTROL DOOR FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Metal Sound Control Interior Door Frames: Full profile/continuously welded type.
 - 1. Frame Finish: Factory primed and field finished.
 - 2. Interior Door Frames, Non-Fire Rated:
 - a. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch (150 mm), maximum, above floor at 45 degree angle.
 - b. Frame Metal Thickness: 14 gauge, 0.067 inch (1.7 mm), minimum.
 - 3. Fire-Rated Door Frames:

- a. Fire Rating: Same as door, and labeled.
 - b. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch (150 mm), maximum, above floor at 45 degree angle.
 - c. Frame Metal Thickness: 14 gauge, 0.067 inch (1.7 mm), minimum.
- C. Provide mortar guard boxes for hardware cut-outs in frames installed in masonry or being grouted.
- D. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inch (102 mm) high to fill opening without cutting masonry units.

2.06 DOOR HARDWARE

- A. Hinges: Cam lift type by door manufacturer, coordinate with Section 08 71 00.
- B. Threshold: Provide sound control/acoustic seal for sill of door in closed position by door manufacturer.
- C. Sound Control Seals: Provide sound control/acoustic seals for jambs and head of door in closed position by door manufacturer.

2.07 FINISHES

- A. Primer, Metal Doors and Frames: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard, in compliance with local VOC requirements.
 - 1. Painting and Cleaning: After fabrication of frames, all tool marks and surface imperfections shall be removed and exposed faces of all welded joints dressed smooth. Chemically treat all surfaces to insure maximum paint adhesion and coat with a water-based rust-inhibitive primer.
- B. Metal Door and Frame Finish: Factory primed and field finished.
 - 1. Color: As indicated on drawings.
- C. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

2.08 ACCESSORIES

- A. Grout for Frames: Portland cement grout with maximum of 4 inch (102 mm) slump for hand troweling; thinner pumpable grout of higher slump is not permitted.
 - 1. Grouting of frames in drywall/gypsum board construction is not permitted.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.
- B. Coat inside of other frames with bituminous coating to a thickness of 1/16 inch (1.6 mm).

3.03 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- E. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 865.

- F. Coordinate installation of electrical connections to electrical hardware items.
- G. Touch up damaged factory finishes.
- H. After installation, field splices required because of shipping limitations must be field welded by certified welders per manufacturer's instructions and in accordance with AWS D1.1/D1.3.

3.04 TOLERANCES

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 865.
- B. Maximum Diagonal Distortion: 1/16 inch (1.6 mm) measured with straight edge, corner to corner.

3.05 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for independent field testing and inspection requirements, and requirements for monitoring quality of specified product installations.
- B. Provide field testing of installed sound control doors by independent laboratory in accordance with ASTM E336 test methods, with results calculated in accordance with ASTM E413 and having acceptable field noise isolation class (NIC) values within 5 dB of laboratory STC rating values.
 - 1. Testing agency to submit testing report to Contractor and Architect within 24 hours after field testing has been completed.
- C. Repair or replace sound control door components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.06 ADJUSTING

- A. Adjust for smooth and balanced sound control door movement.
- B. Adjust sound control doors so that seals are fully engaged when door is closed.
- C. Adjust sound control doors for force to close, latch, and unlatch; adjust as necessary in compliance with requirements.

3.07 SCHEDULE

- A. Refer to Door and Frame Schedule on drawings.

END OF SECTION

**SECTION 08 38 00
TRAFFIC DOORS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Rigid and semi-rigid traffic doors.
- B. Door accessories.
- C. Door frames.

1.02 RELATED REQUIREMENTS

- A. Section 09 91 23 - Interior Painting; Frame to be painted to match other doors.

1.03 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Manufacturer's technical information for each type of door specified, including details about materials, components, profiles, gaskets, and finishes; include:
 - 1. Preparation and installation instructions and methods.
 - 2. Storage and handling requirements and recommendations.
 - 3. Operation and maintenance data.
- C. Shop Drawings: Indicate installation details of doors and frames, including elevations and attachment.
- D. Samples: Two color charts indicating full range of available colors and textures for each type of finish.
- E. Manufacturer's qualification statement.
- F. Executed warranty.

1.04 QUALITY ASSURANCE

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

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver product in manufacturer's original unopened packages with label legible and intact.
- B. Store doors at project site on edge or in upright position, under cover and elevated above grade, following manufacturer's instructions.

1.06 WARRANTY

- A. See Section 01 77 00-Closeout Procedures. for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty for molded polyethylene doors against damage due to vehicle traffic; state limitations in executed warranty. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS**2.01 RIGID AND SEMI-RIGID TRAFFIC DOORS**

- A. Construction: Manufacturer's standard.
 - 1. Door Assemblies: Double-acting, self-closing pairs of doors prehung in frame; factory fabricated and finished, complete with hinges and specified accessories.
 - a. Door Swing: Minimum of 90 degrees each direction.
 - b. Hinges: V-cam gravity hinges at top and pivots at bottom; mounted on bottom of header and on top of floor; maximum rise 1-1/2 inches (38 mm); vertical and horizontal adjustment in the field; manufacturer's standard lower hinge guards.
 - c. Hinge Guards: Manufacturer's standard material and configuration to protect lower hinge finish floors from damage.

- d. Exposed Metal Parts: Either stainless steel, extruded aluminum, or powder coated.
 - e. Dimensional Tolerances: Plus or minus 1/4 inch (6 mm) in width and height of each panel.
 - f. Hardware finish should match as closely as possible to hardware finish for other doors in the facility.
- B. Thermoplastic Double-Acting Traffic Doors : Hollow core thermoplastic with high strength polymer cell core.
- 1. Thickness: 1-1/2 inches (38 mm).
 - 2. Faces: 1/8 inch (3 mm) minimum thickness; textured or pebble finish.
 - 3. Construction: Manufacturer's standard construction with faces bonded to thermoplastic or high strength PVC subframe or molded in one piece, reinforced for durability and rigidity, with all edges, cut-outs, and hardware preparations factory fabricated; provide view window cut-outs with joints sealed independently of glazing 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.
 - 5. Gaskets: Replaceable rubber gaskets in key on edge of door.
 - 6. Bumpers: Provide Easy Spring bumpers, 1/4 inch (6 mm) thick, high impact resistant thermoplastic, on both sides of doors.
 - a. Height: 18 inches (457 mm)
 - b. Color: As selected from manufacturer's standard selection.
 - 7. Impact Plates: Provide bumper plates on both sides of doors.
 - 8. Color: Off White.
 - 9. Products:
 - a. Basis of Design: Eliason Corporation; Model HCP-10: www.eliasoncorp.com/#sle.
 - b. Chase Doors: www.chasedoors.com/#sle.
 - c. Rubbair Door, Inc: www.rubbair.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- C. View Windows: Factory installed glazing in molded or extruded black thermoplastic or rubber gasket; centered in door width.
- 1. Rectangular-Shaped Window Size: 14 inches (356 mm) by 16 inches (406 mm).
 - 2. Double Glazing: Clear double glazed acrylic
- D. Impact Plates: Surface applied; factory installed.
- 1. Bumper Plates: 30 inches (762 mm) high by full width of door panel, mounted at bottom of door.
- E. Spring Bumpers: Easy Spring, polyethylene; projecting 3 inches (76 mm) from door panel.
- 1. Color: As selected by Architect from manufacturer's standard selection.
- F. Hinges: Eliason Double Action Easy Swing
- 1. Finish: Zinc coated.

2.02 ACCESSORIES

- A. Frames: Provide doors pre-hung in frames by door manufacturer; tubular steel welded frame.
- B. Provide fasteners and other hardware as recommended by manufacturer for complete installation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that jambs and frames are square and plumb.
- B. Verify that opening is ready to receive work and opening dimensions and clearances are as indicated on drawings.
- C. If substrate preparation is responsibility of another installer, notify Architect of unsatisfactory conditions before proceeding.
- D. Commencement of work by installer indicates acceptance of opening conditions.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.

3.03 INSTALLATION

- A. Install doors with clearances, anchors, hardware, and accessories according to the manufacturer's instructions and as specified.
- B. Install doors plumb, level, and properly aligned.

3.04 ADJUSTING

- A. Clean and lubricate operating parts.
- B. Adjust doors to open and close smoothly and freely without binding and for proper fit of seals.

3.05 CLEANING

- A. Clean surfaces using methods as recommended by manufacturer.

3.06 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 08 43 13
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Aluminum doors and frames.
- C. Weatherstripping.
- D. Door hardware.

1.02 RELATED REQUIREMENTS

- A. Section 07 25 00 - Weather Barriers: Sealing framing to water-resistive barrier installed on adjacent construction.
- B. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.
- C. Section 08 80 00 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.
- B. AAMA 501.1 - Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure; 2017.
- C. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.
- D. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
- E. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
- F. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
- G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- H. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- I. 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.
- J. 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).
- K. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.

1. Provide Product Test Reports for each type of aluminum-framed storefront used in the project. Test reports must be based on evaluation of comprehensive tests performed by a qualified preconstruction testing agency. Test reports must indicate compliance with performance requirements,
- 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.
 1. Include design engineer's stamp or seal on shop drawings for attachments and anchors.
- D. Samples: Submit two samples standard size illustrating finished aluminum surface, glass, infill panels, glazing materials.
- E. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- F. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.
- G. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
- H. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- I. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
- J. Installation Instructions
- K. Installer's qualification statement.
- L. Recycled Content:
 1. Provide documentation that aluminum has a minimum of 50% mixed pre- and post-consumer recycled content.
 2. Provide a sample document illustrating project-specific information that will be provided after product shipment.
 3. After product has shipped, provide project-specific recycled content information:
 - a. Indicate recycled content, including the percentage of pre- and post-consumer recycled content per unit of product.
 - b. Indicate the relative dollar value of recycled content product to the total dollar value of product included in the project.
 - c. Indicate the location for recovery of recycled content.
 - d. Indicate the location of the manufacturing facility.
- M. Material Ingredient Reporting:
 1. Shall have a complete list of chemical ingredients to at least 100 ppm (0.01%) that covers 100% of the product.
 2. Acceptable documentation includes:
 - a. Manufacturer's inventory with Chemical Abstract Service Registration Number (CASRN or CAS#):
 - 1) Kawneer's Material Transparency Summary (MTS)
 - b. Cradle to Cradle certification; either document listed below is acceptable for this option:
 - 1) Cradle to Cradle Certified™ with Material Health section Silver or higher
 - 2) Silver Level or higher Material Health Certificate
 - 3) Red List Free DECLARE label
- N. Environmental Product Declaration (EPD):
 1. Include a Type III Product-Specific EPD created from a Product Category Rule.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- C. Source Limitations: Obtain aluminum-framed storefront system through one source from a single manufacturer

1.07 MOCK-UPS

- A. See Section 01 43 39 - Mockups

1.08 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.

1.09 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.
- B. Verify actual dimensions of aluminum-framed storefront openings by field measurements before fabrication. Indicate measurements on shop drawings.

1.10 WARRANTY

- A. See Section 01 77 00-Closeout Procedures for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. 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.
- D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Aluminum-Framed Storefronts:
 1. Kawneer North America: www.kawneer.com/#sle.
 2. Oldcastle BuildingEnvelope: www.oldcastlebe.com/#sle.
 3. Trulite Glass & Aluminum Solutions, LLC; _____: www.trulite.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

- A. Center-Set Style, Thermally-Broken:
 1. Basis of Design: Kawneer Trifab 451T.
 2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep (51 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. Oldcastle; Series 3000 Thermal Multipane.
- C. Substitutions: See Section 01 60 00 - Product Requirements.
 1. For any product not identified as "Basis of Design", submit information as specified for substitutions.

2.03 BASIS OF DESIGN -- SWINGING DOORS

- A. Wide Stile, Insulating Glazing, Thermally-Broken:
 1. Basis of Design: Kawneer 500.

2. Thickness: 1-3/4 inches (43 mm).

2.04 ALUMINUM-FRAMED STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 1. Basis of Design: Kawneer Trifab 451T Storefront System
 2. Unitized, shop assembly.
 3. Glazing Rabbet: For 1 inch (25 mm) insulating glazing.
 4. Finish: Superior performing organic coatings.
 - 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.
 5. 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.
 6. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 7. 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.
 8. 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.
 9. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
 10. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
 11. Maintain continuous air barrier and/or vapor retarder seal throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel, and heel bead of glazing compound.
 12. Preparation for Window Treatments: Provide reinforced interior horizontal head rail.
- B. Performance Requirements
 1. General Performance:
 - a. Product to comply with the specified performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction, as determined by testing of aluminum storefront systems representing those indicated for this project.
 - b. Aluminum storefront systems shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - c. Failure includes any of these events:
 - 1) Thermal stresses transferring to building structure
 - 2) Glass breakage
 - 3) Loosening or weakening of fasteners, attachments, and other components
 - 4) Failure of operating units
 2. 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 applicable code.
 - b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.

3. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf (390 Pa) as defined in AAMA 501.1 or AAMA 501.2 .
4. Air Leakage
 - a. With interior seal: 0.06 cfm/sq ft (0.3 L/sec sq m) maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 6.27 psf (300 Pa) pressure difference.
 - b. Without interior seal: 0.06 cfm/sq ft (0.3 L/sec sq m) maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf (75 Pa) pressure difference.
 - c. CSA A440 Fixed Rating.
5. Condensation Resistance Factor of Framing (CRF): measured in accordance with AAMA 1503.
 - a. The glass to exterior CRF, shall not be less than 70 (frame) and 69 (glass) for low-e glazing or 69 (frame) and 58 (glass) for clear glazing
 - b. The glass to center CRF, shall not be less than 62 (frame) and 68 (glass) for low-e glazing or 63 (frame) and 56 (glass) for clear glazing
 - c. The glass to interior CRF, shall not be less than 56 (frame) and 67 (glass) for low-e glazing or 54 (frame) and 58 (glass) for clear glazing

2.05 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: Applied.
 2. Cross-Section: 2 by 4-1/2 inch (50.8 by 114.3 mm) nominal dimension.
- B. Glazing: See Section 08 80 00.
- C. Swing Doors: Glazed aluminum.
 1. Basis of Design: Kawneer Wide Stile 500 Series
 - a. Thickness: 1-3/4 inches (43 mm).
 - b. Top Rail: 5 inches (127 mm) wide.
 - c. Vertical Stiles: 5 inches (127 mm) wide.
 - d. Bottom Rail: 10 inches (254 mm) wide.
 - e. Glazing Stops: Beveled.
 - f. Finish: Same as storefront.
 - g. Glazing Thickness:
 - 1) Exterior Applications: 1-inch (25.4 mm).
 - (a) See Section 08 80 00 - Glazing and drawings for the specific IGU.
 - 2) Interior Applications: 1/4-inch (6.35 mm).

2.06 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
 1. 6063-T6 alloy and temper
- B. Fasteners: Stainless steel. Recommended by manufacturer for the supplied system.
- C. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch (0.81 mm) minimum thickness; finish to match framing members.
- D. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

2.07 FINISHES

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.

2.08 HARDWARE

- A. For each door, include weatherstripping, sill sweep strip, and threshold.
- B. Other Door Hardware: Storefront manufacturer's standard type to suit application.
 - 1. Finish on Hand-Contacted Items: Polished stainless steel.
 - 2. For each door, include pivots, push handle, pull handle, exit device, narrow stile handle latch, closer, and continuous hinges.

PART 3 EXECUTION**3.01 EXAMINATION**

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

3.02 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. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- I. Set thresholds in bed of sealant and secure.
- J. Install hardware using templates provided.
- K. Install glass and infill panels using glazing method required to achieve performance criteria; see Section 08 80 00.
- L. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet (1.5 mm per m) non-cumulative or 0.06 inch per 10 feet (1.5 mm per 3 m), whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

3.04 FIELD QUALITY CONTROL

- A. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.
 - B. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
 - 1. Perform a minimum of two tests in each designated area as indicated on drawings.
 - 2. Conduct tests in each area prior to 50 percent and 70 percent completion of this work.
 - C. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.
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3.05 ADJUSTING

- A. Adjust operating hardware and sash for smooth operation.

3.06 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, and take care to remove dirt from corners and to wipe surfaces clean.
- C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.07 PROTECTION

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

END OF SECTION

**SECTION 08 71 00
DOOR HARDWARE****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Mechanical door hardware for swinging doors.
- B. Hardware for fire-rated doors.
- C. Electrically operated and controlled hardware.
- D. Lock cylinders for doors that hardware is specified in other sections.
- E. Thresholds.
- F. Weatherstripping and gasketing.

1.02 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants: Sealants for setting exterior door thresholds.
- B. Section 08 06 71 - Door Hardware Schedule: Schedule of door hardware sets.
- C. Section 08 11 13 - Hollow Metal Doors and Frames.
- D. Section 08 14 16 - Flush Wood Doors.
- E. Section 08 43 13 - Aluminum-Framed Storefronts: Door hardware, except as noted in section.
- F. Section 08 71 13 - Automatic Door Operators
- G. Section 10 14 00 - Signage: Additional signage requirements.
- H. Section 26 05 83 - Wiring Connections: Power supply to electric hardware devices.
- I. Section 10 26 00 - Wall and Door Protection: Door and frame protection.
- J. Section 28 13 00 - Access Control System: Electronic access control devices.
- K. Section 28 46 00 - Fire Detection and Alarm: Electrical connection to activate door closers.
- L. Section 28 31 11 - Building Intrusion Detection: Building monitoring system.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
 - B. BHMA (CPD) - Certified Products Directory; Current Edition.
 - C. BHMA A156.1 - Standard for Butts and Hinges; 2021.
 - D. BHMA A156.2 - Bored and Preassembled Locks and Latches; 2022.
 - E. BHMA A156.3 - Exit Devices; 2020.
 - F. BHMA A156.4 - Door Controls - Closers; 2019.
 - G. BHMA A156.6 - Standard for Architectural Door Trim; 2021.
 - H. BHMA A156.7 - Template Hinge Dimensions; 2016.
 - I. BHMA A156.8 - Door Controls - Overhead Stops and Holders; 2021.
 - J. BHMA A156.13 - Mortise Locks & Latches Series 1000; 2022.
 - K. BHMA A156.15 - Release Devices - Closer Holder, Electromagnetic and Electromechanical; 2021.
 - L. BHMA A156.16 - Auxiliary Hardware; 2023.
 - M. BHMA A156.18 - Materials and Finishes; 2020.
 - N. BHMA A156.20 - Standard for Strap and Tee Hinges, and Hasps; 2021.
 - O. BHMA A156.21 - Thresholds; 2019.
 - P. BHMA A156.22 - Standard for Gasketing; 2021.
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- Q. BHMA A156.26 - Standard for Continuous Hinges; 2021.
- R. BHMA A156.28 - Standard for Recommended Practices for Mechanical Keying Systems; 2023.
- S. BHMA A156.31 - Electric Strikes and Frame Mounted Actuators; 2019.
- T. BHMA A156.36 - Auxiliary Locks; 2020.
- U. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.
- V. BHMA A156.115W - Hardware Preparation in Wood Doors with Wood or Steel Frames; 2006.
- W. DHI (H&S) - Sequence and Format for the Hardware Schedule; 2019.
- X. DHI (KSN) - Keying Systems and Nomenclature; 2019.
- Y. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors; 1993; also in WDHS-1/WDHS-5 Series, 1996.
- Z. ICC A117.1-2009 - Accessible and Usable Buildings and Facilities; 2009.
- AA. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- BB. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- CC. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- DD. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.
- EE. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- FF. UL (DIR) - Online Certifications Directory; Current Edition.
- GG. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- HH. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.
- B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.
- C. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; attendance is required by affected installers and the following:
 - 1. Architect.
 - 2. Installer's Architectural Hardware Consultant (AHC).
 - 3. Hardware Installer.
 - 4. Owner's Security Consultant.
 - 5. Owner's Representative.
- D. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
- E. Keying Requirements Meeting:
 - 1. Conduct meeting at Project Site to comply with requirements of Section 01 31 13 - Project Coordination.
 - 2. Attendance Required:
 - a. Contractor.
 - b. Owner.
 - c. Architect.
 - d. Installer's Architectural Hardware Consultant (AHC).

- e. Hardware Installer.
- f. Owner's Security Consultant.
3. Agenda:
 - a. Establish keying requirements.
 - b. Verify locksets and locking hardware are functionally correct for project requirements.
 - c. Verify that keying and programming complies with project requirements.
 - d. Establish keying submittal schedule and update requirements.
4. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system including, but not limited to, the following:
 - a. Access control requirements.
 - b. Key control system requirements.
 - c. Schematic diagram of preliminary key system.
 - d. Flow of traffic and extent of security required.
5. Record minutes and distribute copies within five days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.
6. Deliver established keying requirements to manufacturers.

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required 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, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.
- C. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.
 1. Prepared by or under supervision of Installer's Architectural Hardware Consultant (AHC).
 2. Comply with DHI (H&S) using door numbers and hardware set numbers as indicated in construction documents.
 3. List groups and suffixes in proper sequence.
 4. Provide complete description for each door listed, including Identification number, location, hand, fire-rating, size and material of each door and frame.
 5. Provide manufacturer name, product names, and catalog numbers; include functions, types, styles, sizes and finishes of each item.
 6. Include account of abbreviations and symbols used in schedule.
 7. Include location of each door hardware set, cross-referenced to Drawings on floor plans and to Door and Frame Schedule.
- D. Shop Drawings - Electrified Door Hardware Schedule: Submit diagrams for power, signal, and control wiring for electrified door hardware that include details of interface with building safety and security systems. Provide elevations and diagrams for each electrified door opening as follows:
 1. Prepared by or under supervision of Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC).
 2. Elevations: Submit front and back elevations of each door opening showing electrified devices with connections installed and an operations narrative describing how opening operates from either side at any given time.
 3. Diagrams: Submit point-to-point wiring diagram that shows each device in door opening system with related colored wire connections to each device.
- E. Samples for Verification:
 1. Submit minimum size of 2 by 4 inch (51 by 102 mm) for sheet samples, and minimum length of 4 inch (102 mm) for other products.
 2. Submit one (1) sample of hinge, latchset, and lockset illustrating style, color, and finish.
 3. Return full-size samples to Contractor.

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4. Submit product description with samples.
 - F. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
 - G. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
 1. Submit manufacturer's parts lists and templates.
 2. Bitting List: List of combinations as furnished.
 - H. Keying Schedule:
 1. Submit electronic copies of Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.
 - I. Installer's qualification statement.
 - J. Supplier's qualification statement.
 - K. Project Record Documents:
 1. Record actual locations of concealed equipment, services, and conduit.
 2. Schedules shall be kept current with all changes to the project. If changes occur, project hardware scheduled shall be maintained to reflect the changes as they are approved. Omitted items shall be deleted from openings, added and replaced items shall be included.
 3. Installation submittals shall be kept current as changes occur.
 4. Upon request, a complete updated hardware schedule shall be provided to the contractor.
 5. Supplemental submittals that include only the changed openings will not be acceptable.
 6. Prior to final payment, provide a record copy of hardware schedules, including all revisions and updates. All openings shall be listed to reflect final installed configuration only.
 - L. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.
 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 2. Lock Cylinders: Ten for each master keyed group.
 3. Tools: One set of each special wrench or tool applicable for each different or special hardware component, whether supplied by hardware component manufacturer or not.

1.06 QUALITY ASSURANCE

- A. Standards for Fire-Rated Door Assemblies: Maintain one copy of each referenced standard on site, for use by Architect and Contractor.
- B. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least three years of documented experience.
- C. Supplier Qualifications: Company shall be a corporate member in good standing of The Door and Hardware Institute (DHI), employing at least one certified Architectural Hardware Consultant (AHC) who is currently participating in DHI's continuing education program (CEP)
 1. Supplier shall also employ or contract with an Electricied Hardware Consultant (EHC) to assist in the work of this section as required,

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping
- C. Deliver keys to Owner by registered mail or overnight package service.

1.08 WARRANTY

- A. See Section 01 77 00-Closeout Procedures. for additional warranty requirements.
 - B. Manufacturer's Warranty: Provide warranty against defects in material and workmanship for period indicated. Complete forms in Owner's name and register with manufacturer.
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1. Closers: Five years, minimum.
2. Exit Devices: Three years, minimum.
3. Locksets and Cylinders: Three years, minimum.
4. Other Hardware: Two years, minimum.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

- A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.
- B. Provide individual items of single type, of same model, and by same manufacturer, unless otherwise in
- C. Provide door hardware products that comply with the following requirements:
 1. Applicable provisions of federal, state, and local codes.
 2. Accessibility: ADA Standards and ICC A117.1.
 - a. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N)
 - b. Comply with the following maximum opening-force requirements
 - 1) Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 - 2) Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
 - 3) Fire Doors: Minimum opening force allowable by authorities having jurisdiction
 - c. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high
 - d. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a point 12 degrees from the latch, measured to the leading edge of the door
 3. Applicable provisions of NFPA 101.
 4. Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation
 5. Fire-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
 6. Hardware on Fire-Rated Doors: Listed and classified by UL (DIR) or testing firm acceptable to authorities having jurisdiction as suitable for application indicated.
 7. Hardware for Smoke and Draft Control Doors (Indicated as "S" on Drawings): Provide door hardware that complies with local codes, and requirements of assemblies tested in accordance with UL 1784.
 - a. Air Leakage Rate: Tested in accordance with UL 1784, with air leakage rate not to exceed 3.0 cfm/sf (0.01524 cu m/sec/sq m) of door opening at 0.10 inch (24.9 Pa) of water for both ambient and elevated temperature tests.
 8. Listed and certified compliant with specified standards by BHMA (CPD).
 9. Auxiliary Hardware: BHMA A156.16.
 10. Straps and Tee Hinges: BHMA A156.20.
 11. Hardware Preparation for Steel Doors and Steel Frames: BHMA A156.115.
 12. Hardware Preparation for Wood Doors with Wood or Steel Frames: BHMA A156.115W.
 13. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.
- D. Electrically Operated and/or Controlled Hardware: Provide necessary power supplies, power transfer hinges, relays, and interfaces as required for proper operation; provide wiring between hardware and control components and to building power connection in compliance with NFPA 70.
 1. Equipment shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
 2. See Section 28 10 00 for additional access control system requirements.

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- E. Lock Function: Provide lock and latch function numbers and descriptions of manufacturer's series. See Door Hardware Schedule.
- F. Fasteners:
1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
 - a. Aluminum fasteners are not permitted.
 - b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.
 2. Provide machine screws for attachment to reinforced hollow metal and aluminum frames.
 - a. Self-drilling (Tek) type screws are not permitted.
 3. For wood doors, comply with the requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
 4. Provide stainless steel machine screws and lead expansion shields for concrete and masonry substrates.
 5. Fire-Rated Applications: Comply with NFPA 80.
 - a. Provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames.
 - b. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to hollow metal door panels unless proper door blocking is provided.
 6. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt
 7. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.
- G. Scope of Work
1. Items of hardware not definitely specified herein but necessary for completion of the work shall be provided. Such items shall be of type and quality suitable to the service required and comparable to the adjacent hardware. Where size and shape of members is such as to prevent the use of types specified, hardware shall be furnished of suitable types having as nearly as practicable the same operation and quality as the type specified. Sizes shall be adequate for the service required
 - a. Include such nuances as strike type, strike lip length, raised barrel hinges, mounting brackets, blade stop spacers, special templates, fasteners, shims, and coordination between conflicting products. All doors shall be provided with a stop

2.02 BUTT HINGES

- A. Manufacturers:
1. McKinney; an Assa Abloy Group company: www.assaabloydss.com/#sle.
 2. Hager Companies: www.hagerco.com/#sle.
 3. Ives, an Allegion brand[<>]: www.allegion.com/us/#sle.
- B. Hinges: Comply with BHMA A156.1.
1. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7 for templated hinges.
 - a. Provide hinge width required to clear surrounding trim.
 - b. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames
 2. Provide hinges on every swinging door.
 - a. Interior Door Hinges:
 - 1) Steel, 0.134 inch minimum thickness except as noted.
 - 2) Provide heavyweight 0.180 inch minimum thickness on doors wider than 3'0".

- b. Exterior Door Hinges:
 - 1) Stainless steel, provide heavyweight 0.180 inch minimum thickness unless noted otherwise
- 3. Size: 4-1/2" x 4-1/2" unless noted otherwise
- 4. Options:
 - a. Nonremovable Pins: Provide set screw in hinge barrel that when tightened into a groove in hinge pin, prevents removal of pin while door is closed;
 - 1) for out-swinging exterior doors, out-swinging lockable corridor doors and doors with access control components
 - b. Corners: Square
- 5. Provide power transfer hinges where electrified hardware is mounted in door leaf.
- 6. Provide following quantity of butt hinges for each door, unless otherwise indicated
 - a. Doors up to 60 inches (1.5 m) High: Two hinges.
 - b. Doors From 60 inches (1.5 m) High up to 90 inches (2.3 m) High: Three hinges.
 - c. Doors 90 inches (2.3 m) High up to 120 inches (3 m) High: Four hinges.
 - d. Doors over 120 inches (3 m) High: One additional hinge per each additional 30 inches (762 mm) in height.
 - e. Dutch Doors: Two hinges each leaf.

2.03 CONTINUOUS HINGES

- A. Manufacturers:
 - 1. Architectural Builders Hardware (ABH)
 - 2. Hager Companies: www.hagerco.com/#sle.
 - 3. Ives, an Allegion brand[<>]: www.allegion.com/us/#sle.
 - 4. Pemko; an Assa Abloy Group company: www.assaabloydss.com/#sle.
- B. Hinges: Comply with BHMA A156.1.
 - 1. Continuous Hinges: Comply with BHMA A156.26.
 - a. Minimum 0.120-inch- (3.0-mm-) thick, hinge leaves with minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.
 - 2. Continuous, Gear-Type Hinges: Comply with BHMA A156.26.
 - a. Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings

2.04 FLUSH BOLTS

- A. Manufacturers:
 - 1. Hager Companies: www.hagerco.com/#sle.
 - 2. Ives, an Allegion brand: www.allegion.com/us/#sle.
 - 3. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 4. Trimco: www.trimcohardware.com/#sle.
- B. Flush Bolts: Comply with BHMA A156.16.
 - 1. Flush Bolt Throw: 3/4 inch (19 mm), minimum.
 - a. Designed for mortising into door edge
 - 2. 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.
 - 4. Self-Latching Flush Bolts: Automatically latch upon closing of door; manually retracted; located on inactive leaf of pair of doors.
 - 5. Automatic Flush Bolts: Automatically latch upon closing of door; automatic retraction of bolts when active leaf is opened; located on inactive leaf of pair of doors.

2.05 EXIT DEVICES

- A. Manufacturers:
 - 1. Von Duprin, an Allegion brand: www.allegion.com/us/#sle.
 - 2. Sargent, an ASSA Abloy GrCompany. www.assaabloydss.com/#sle.
- B. Exit Devices: Comply with BHMA A156.3.
 - 1. Lever design to match lockset trim.
 - 2. Provide cylinder with cylinder dogging or locking trim.
 - 3. Provide exit devices properly sized for door width and height.
 - 4. Provide strike as recommended by manufacturer for application indicated.
 - 5. Provide UL (DIR) listed exit device assemblies for fire-rated doors and panic device assemblies for non-fire-rated doors.
 - 6. For electrical options, provide quick connect plug-in pre-wired connectors.

2.06 ELECTRIC STRIKES

- A. Manufacturers:
 - 1. Von Duprin, an Allegion brand: www.allegion.com/us/#sle.
 - 2. HES.
- B. Electric Strikes: Comply with BHMA A156.31.
 - 1. Provide UL (DIR) listed burglary-resistant electric strike; style to suit locks.
 - 2. Provide non-handed 24 VDC electric strike suitable for door frame material and scheduled lock configuration.

2.07 CYLINDRICAL LOCKS

- A. Manufacturers:
 - 1. City of Madison Parks Division:
 - a. Primus by [Schlage Commercial Lock Division](#), www.allegion.com/us/#sle. (No Substitutions)
 - 2. City of Madison Library Division:
 - a. Sargent, an ASSA Abloy Company, www.assaabloydss.com/#sle. (No Substitutions)
- B. Cylindrical Locks (Bored): Comply with BHMA A156.2, Grade 2, 4000 Series.
 - 1. Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver
 - 2. Bored Hole: 2-1/8 inch (54 mm) diameter.
 - 3. Latchbolt Throw: 1/2 inch (12.7 mm), minimum.
 - 4. Backset: 2-3/4 inch (70 mm) unless otherwise indicated.
 - 5. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
 - a. Finish: To match lock or latch.
 - b. Flat-Lip Strikes: Provide for locks with three piece antifriction latchbolts as recommended by manufacturer.
 - c. Extra-Long-Lip Strikes: Provide for locks used on frames with applied wood casing trim.
 - d. Aluminum-Frame Strike Box: Provide strike box fabricated for use with aluminum framing by framing manufacturer.
 - e. Rabbet Front and Strike: Provide on locksets for use with rabbeted meeting rails.
 - 6. Provide a lock for each door, unless otherwise indicated that lock is not required.
 - 7. Trim: Provide lever handle or pull trim on outside of each lock, unless otherwise indicated.

2.08 MORTISE LOCKS

- A. Manufacturers:
 - 1. City of Madison Parks Division:
 - a. Primus by [Schlage Commercial Lock Division](#), www.allegion.com/us/#sle. (No Substitutions)
 - 2. City of Madison Library Division:

- a. Sargent, an ASSA Abloy Company, www.assaabloydss.com/#sle. (No Substitutions)
- B. Mortise Locks: Comply with BHMA A156.13, Grade 1, Operational, 1000 Series.
 - 1. Stamped steel case with steel or brass parts
 - 2. Latchbolt Throw: 3/4 inch (19 mm), minimum.
 - 3. Deadbolt Throw: 1 inch (25.4 mm), minimum.
 - 4. Backset: 2-3/4 inch (70 mm) unless otherwise indicated.
 - 5. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
 - a. Flat-Lip Strikes: Provide for locks with three piece antifriction latchbolts as recommended by manufacturer.
 - b. Extra-Long-Lip Strikes: Provide for locks used on frames with applied wood casing trim.
 - c. Aluminum-Frame Strike Box: Provide strike box fabricated for use with aluminum framing by framing manufacturer.
 - d. Rabbet Front and Strike: Provide on locksets for use with rabbeted meeting rails.
 - e. Finish: To match lock or latch.

2.09 AUXILIARY LOCKS (DEADLOCKS)

- A. Manufacturers:
 - 1. For Bored Auxiliary Locks
 - a. Schlage Commercial Lock Division, www.allegion.com/us/#sle
 - 2. For Narrow Stile Auxiliary Locks
 - a. Adams Rite, an Assa Abloy Group company: www.assaabloydss.com/#sle.
- B. Locks that typically are used in addition to latch bolts and that are operated by a knob, lever, or thumbpiece.
- C. Auxiliary Locks (Deadlocks): Comply with BHMA A156.36, Grade 1.
 - 1. Type: Bored (cylindrical).
 - 2. Application: Bored.
 - 3. Provide strike that matches frame.

2.10 DOOR PULLS AND PUSH PLATES

- A. Manufacturers:
 - 1. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 2. Hager Companies: www.hagerco.com/#sle.
 - 3. Ives, an Allegion brand: www.allegion.com/us/#sle.
 - 4. Trimco: www.trimcohardware.com/#sle.
- B. Door Pulls and Push Plates: Comply with BHMA A156.6.
 - 1. Pull Type: Straight, unless otherwise indicated.
 - 2. Push Plate Type: Flat, with square corners, unless otherwise indicated.
 - a. Edges: Beveled, unless otherwise indicated.
 - 3. Material: Stainless steel, unless otherwise indicated.

2.11 DOOR PULLS AND PUSH BARS

- A. Manufacturers:
 - 1. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 2. Hager Companies: www.hagerco.com/#sle.
 - 3. Ives, an Allegion brand: www.allegion.com/us/#sle.
 - 4. Trimco: www.trimcohardware.com/#sle.
- B. Door Pulls and Push Bars: Comply with BHMA A156.6.
 - 1. Bar Type: Push bar, unless otherwise indicated.
 - 2. Material: Stainless steel, unless otherwise indicated.

2.12 COORDINATORS

- A. Manufacturers:
 - 1. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 2. Hager Companies: www.hagerco.com/#sle.
 - 3. Ives, an Allegion brand: www.allegion.com/us/#sle.
 - 4. Trimco: www.trimcohardware.com/#sle.
- B. Coordinators: Provide on pairs of doors having closers and self-latching or automatic flush bolts to ensure that inactive door leaf closes before active door leaf.
 - 1. Comply with BHMA A156.3
 - 2. Type: consisting of active-leaf, hold-open lever and inactive-leaf release trigger, unless otherwise indicated.
 - 3. Material: fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release; and with internal override, unless otherwise indicated.
 - 4. Ensure that coordination of other door hardware affected by placement of coordinators and carry bar is applied properly for completely operable installation.

2.13 CARRY BAR

- A. Manufacturers:
 - 1. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 2. Hager Companies: www.hagerco.com/#sle.
 - 3. Ives, an Allegion brand: www.allegion.com/us/#sle.
 - 4. Trimco: www.trimcohardware.com/#sle.
- B. Carry-Open Bar: For pairs of doors - provides a push on active door when inactive door is opened first to allow coordinator to be engaged for proper door leaf closing sequence.
 - 1. Comply with BHMA A156.3
 - 2. Provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.

2.14 CLOSERS

- A. Manufacturers; Surface Mounted:
 - 1. LCN, an Allegion brand: www.allegion.com/us/#sle.
 - 2. Sargent; an Assa Abloy Group company: www.assaabloydss.com/#sle.
- B. Closers: Comply with BHMA A156.4.
 - 1. Type: Surface mounted to door.
 - a. Rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm.
 - b. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use.
 - c. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force
 - 2. Provide door closer on each exterior door.
 - 3. Provide door closer on each fire-rated and smoke-rated door.
 - a. Spring hinges are not an acceptable self-closing device, unless otherwise indicated.
 - 4. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.
 - 5. At corridor entry doors, mount closer on room side of door.
 - 6. At outswinging exterior doors, mount closer on interior side of door.

2.15 OVERHEAD STOPS AND HOLDERS

- A. Manufacturers:
 - 1. Rixson or Sargent; an Assa Abloy Group company: www.assaabloydss.com/#sle.

2. Glynn-Johnson, an Allegion brand: www.allegion.com/us/#sle.
- B. Overhead Stops and Holders (Door Checks): Comply with BHMA A156.8.
 1. Provide stop for every swinging door, unless otherwise indicated.

2.16 PROTECTION PLATES

- A. Manufacturers:
 1. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
 2. Hager Companies: www.hagerco.com/#sle.
 3. Ives, an Allegion brand: www.allegion.com/us/#sle.
 4. Trimco: www.trimcohardware.com/#sle.
- B. Protection Plates: Comply with BHMA A156.6.
- C. Metal Properties: Stainless steel material.
 1. Metal, Standard Duty: Thickness 0.050 inch (1.27 mm), minimum.
- D. Edges: Beveled, on four sides unless otherwise indicated.
- E. Fasteners: Countersunk screw fasteners.

2.17 KICK PLATES

- A. Manufacturers:
 1. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
 2. Hager Companies: www.hagerco.com/#sle.
 3. Ives, an Allegion brand: www.allegion.com/us/#sle.
 4. Trimco: www.trimcohardware.com/#sle.
- B. Kick Plates: Provide along bottom edge of push side of every door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
 1. See 08 06 71 - Door Hardware Schedule for Hardware Groups.
 2. Size: As indicated in Hardware Groups in Door Hardware Schedule.

2.18 ELECTROMAGNETIC DOOR HOLDERS

- A. Manufacturers:
 1. Rixon Specialty Door Controls; an Assa Abloy Group company: www.assaabloydss.com/#sle.
 2. LCN, an Allegion brand: www.allegion.com/us/#sle.
 3. Architectural Builders Hardware (ABH)
- B. Electromagnetic Door Holders: Comply with BHMA A156.15, Grade 1.
 1. Type: Wall mounted, single unit, standard duty, with strike plate attached to door.
 2. Holding Force, Standard Duty: 40 lbs-force (177 N), minimum.
 3. Voltage: 12 VDC, and provide power supplies by same manufacturer as holders.
 4. Provide interface with fire detectors and fire-alarm system for fire-rated door assemblies.

2.19 FLOOR STOPS

- A. Manufacturers:
 1. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
 2. Hager Companies: www.hagerco.com/#sle.
 3. Trimco: www.trimcohardware.com/#sle.
 4. Ives, an Allegion brand: www.allegion.com/us/#sle.
- B. Floor Stops: Comply with BHMA A156.16 and Resilient Material Retention Test as described in this standard.
 1. Provide floor stops when wall surface is not available; be cautious not to create a tripping hazard.
 2. Type: Manual hold-open, with dome floor stop.
 3. Material: Brass housing with rubber insert.

4. Finish: Match latch or lock.

2.20 WALL STOPS

- A. Manufacturers:
 1. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
 2. Hager Companies: www.hagerco.com/#sle.
 3. Trimco: www.trimcohardware.com/#sle.
 4. Ives, an Allegion brand: www.allegion.com/us/#sle.
- B. Wall Stops: Comply with BHMA A156.16 and Resilient Material Retention Test as described in this standard.
 1. Type: Bumper, concave, wall stop.
 2. Material: Brass housing with rubber insert.
 3. Finish: Match latch or lock.

2.21 ASTRAGALS

- A. Manufacturers:
 1. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
 2. Hager Companies: www.hagerco.com/#sle.
 3. Trimco: www.trimcohardware.com/#sle.
 4. Ives, an Allegion brand: www.allegion.com/us/#sle.
- B. Astragals: Comply with BHMA A156.22.
 1. Provide surface mounted astragal to cover or fill space for full door height between pair of doors or door and adjacent jamb.
 2. Type: Overlapping, flat type, with coordinator for proper door closing sequence, and with sealing gasket.
 3. Material: Wood.
 4. Provide non-corroding fasteners at exterior locations.

2.22 THRESHOLDS

- A. Manufacturers:
 1. Pemko; an Assa Abloy Group company: www.assaabloydss.com/#sle.
 2. Hager Companies: www.hagerco.com/#sle.
 3. National Guard Products, Inc: www.ngpinc.com/#sle.
 4. Zero International, Inc: www.zerointernational.com/#sle.
- B. Thresholds: Comply with BHMA A156.21.
 1. Provide threshold at each exterior door, unless otherwise indicated.
 2. Type: Flat surface.
 3. Material: Aluminum.
 4. Threshold Surface: Fluted horizontal grooves across full width.
 5. Field cut threshold to profile of frame and width of door sill for tight fit.
 6. Provide non-corroding fasteners at exterior locations.

2.23 WEATHERSTRIPPING AND GASKETING

- A. Manufacturers:
 1. Pemko; an Assa Abloy Group company: www.assaabloydss.com/#sle.
 2. Hager Companies: www.hagerco.com/#sle.
 3. National Guard Products, Inc: www.ngpinc.com/#sle.
 4. Zero International, Inc: www.zerointernational.com/#sle.
- B. Weatherstripping and Gasketing: Comply with BHMA A156.22.

1. Air leakage not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer
2. Provide gasketing for smoke and draft control doors (Indicated as "S" on Drawings) that complies with local codes, requirements of assemblies tested in accordance with UL 1784.
3. Provide weatherstripping on each exterior door at head, jambs, and meeting stiles of door pairs, unless otherwise indicated.
4. Provide door bottom sweep on each exterior door, unless otherwise indicated, forming seal when door is closed.
5. Provide sound-rated gasketing and automatic door bottom on doors indicated as "Sound-Rated", "Acoustical", or with "Sound Transmission Class (STC) rating"; fabricate as continuous gasketing, do not cut or notch gasketing material.

2.24 AUXILIARY DOOR HARDWARE

- A. Comply with BHMA A156.16
- B. Manufacturers:
 1. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
 2. Hager Companies: www.hagerco.com/#sle.
 3. Trimco: www.trimcohardware.com/#sle.
 4. Ives, an Allegion brand: www.allegion.com/us/#sle.

2.25 KEY CONTROL SYSTEMS

- A. Key Control Systems: Comply with guidelines of BHMA A156.28., Appendix A
 1. Provide keying information in compliance with DHI (KSN) standards.
 - a. Incorporate decisions made in Keying Requirements Meeting.
 2. Keying: Grand master keyed. Change keys, a master key and a grand master key operate cylinders.
 3. Include construction keying and control keying with removable core cylinders.
 4. Supply keys in following quantities:
 - a. 1 extra key blank for each lock
 - b. 5 each Master keys.
 - c. 5 each Grand Master keys.
 - d. 3 Cylinder Change Keys.
 5. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: _____ [to be provided by Owner]
 6. Provide key collection envelopes, receipt cards, and index cards in quantity suitable to manage number of keys.
 7. Deliver keys with identifying tags to Owner by security shipment direct from hardware supplier.

2.26 KEY CONTROL CABINET

- A. Manufacturers:
 1. [American Key Boxes and Cabinets.](#)
 2. [GE Security, Inc.](#)
 3. [HPC, Inc.](#)
 4. [Lund Equipment Co., Inc.](#)
 5. [MMF Industries.](#)
 6. Tri Palm International
 7. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Key Cabinet: Sheet steel construction; BHMA A156.5

1. Mounting: Wall-mounted with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock..
2. Capacity: 150% of the number of locks.
3. Horizontal metal hook strips with replaceable labels covered with clear plastic (or equivalent).
4. Size key hooks to hold 6 keys each.
5. (2) sets of key tags with self-locking key holders
6. Key gathering envelopes with temporary and permanent markers
7. Finish: Baked enamel, manufacturer's standard color.

2.27 POWER SUPPLY

- A. Power Supply: Hard wired, with multiple zones providing eight (8) breakers for each output panel with individual control switches and LED's; UL (DIR) Class 2 listed.
 1. Power: 24 VAC, 10 Amp; with 120 VAC power supply.
 2. Operating Temperature: 32 to 110 degrees F (0 to 43 degrees C).
 3. Provide with emergency release terminals that release devices upon activation of fire alarm system.
 4. Location: Locate boxed power supplies as indicated or, if not indicated, in equipment room. Verify location with Architect.
 5. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware

2.28 FINISHES

- A. Finishes: Complying with BHMA A156 Identified in Section 08 06 71 - Door Hardware Schedule.
 1. Exceptions:
 - a. Where base material metal is specified to be different, provide finish that is an equivalent appearance in accordance with BHMA A156.18.
 - b. Hinges for Fire-Rated Doors: Steel base material with painted finish, in compliance with NFPA 80.
 - c. Door Closer Covers and Arms: Color as selected by Architect from manufacturer's standard colors unless otherwise indicated.
 - d. Aluminum Surface Trim and Gasket Housings: Anodized to match door panel finish, not other hardware, unless otherwise indicated.
 - e. Hardware for Aluminum Entrance Doors: Finished to match door panel finish, except at hand contact surfaces provide stainless steel with satin finish, unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and applicable codes.
 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- B. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.
- C. Install hardware for smoke and draft control doors in accordance with NFPA 105.
- D. Use templates provided by hardware item manufacturer.
- E. Do not install surface mounted items until application of finishes to substrate are fully completed.

1. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work.
- F. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.
 1. For Steel Doors and Frames: Install in compliance with ANSI/SDI A250.8. Also see Section 08 11 13.
 2. For Aluminum-Framed Storefront Doors and Frames: See Section 08 43 13.
 3. For Wood Doors: Install in compliance with recommendations of DHI WDHS.3 "Recommended Locations for Architectural Hardware for Wood Flush Doors" and DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors" .
 4. Mounting heights in compliance with ADA Standards:
 - a. Locksets: 40-5/16 inch (1024 mm).
 - b. Push Plates/Pull Bars: 42 inch (1067 mm).
 - c. Deadlocks (Deadbolts): 48 inch (1219 mm).
 - d. Exit Devices: 40-5/16 inch (1024 mm).
 - e. Door Viewer: 43 inch (1092 mm); standard height 60 inch (1524 mm).
- G. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.
 1. See Section 07 92 00 - Joint Sealants for additional requirements.
- H. Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

3.03 FIELD QUALITY CONTROL

- A. Perform field inspection and testing under provisions of Section 01 45 16-Field Quality Control Procedures for City of Madison requirements.
- B. Provide an Architectural Hardware Consultant (AHC) to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

3.04 ADJUSTING

- A. Adjust work under provisions of Section 01 77 00-Closeout Procedures.
- B. Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended.
- C. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
- D. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.05 CLEANING

- A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.
- B. Clean adjacent surfaces soiled by hardware installation.
- C. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.
- D. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

3.06 PROTECTION

- A. Protect finished Work under provisions of Section 01 77 00-Closeout Procedures.
- B. Do not permit adjacent work to damage hardware or finish.

END OF SECTION

SECTION 08 71 13
AUTOMATIC DOOR OPERATORS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes the following types of automatic door operators:
 - 1. Exterior and interior, automatic door operators, low energy, with visible mounting.
 - 2. Automatic door operators shall be configured for doors as follows:
 - a. Simultaneous pairs, out swing, in swing, or double egress.
 - b. Simultaneous pairs, with single operator, out swing or in swing.
 - c. Single doors, out swing or in swing.

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 08 71 00 - Door Hardware: Balance of door hardware.
- C. Section 26 05 83 - Wiring Connections.
- D. Section 28 10 00 - Access Control: Connection to access control system; access control devices used as actuators.
- E. Section 28 46 00 - Fire Detection and Alarm: Connection to fire alarm system.
- F.
- G. Division 8 Section "Aluminum-Framed Entrances and Storefronts" for entrances furnished separately in Division 8 Section.
- H. Division 26 Sections for electrical connections including conduit and wiring for power to, and control of, automatic door operators.

1.03 REFERENCES

- A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to 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. Underwriters Laboratories (UL):
 - 1. UL 325 – Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.
 - 2. UL 10C – Positive Pressure Fire Tests of Door Assemblies
- C. American National Standards Institute (ANSI)/Builders' Hardware Manufacturers Association (BHMA):
 - 1. ANSI/BHMA A156.19: Standard for Power Assist and Low Energy Power Operated Doors.
- D. American Society for Testing and Materials (ASTM):
 - 1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
- E. American Association of Automatic Door Manufacturers (AAADM):
- F. International Code Council (ICC):
 - 1. IBC: International Building Code
- G. Building Officials and Code Administrators International (BOCA), 1999:
- H. National Fire Protection Association (NFPA):
 - 1. NFPA 101 – Life Safety Code.
 - 2. NFPA 70 – National Electric Code.

- I. International Standards Organization (ISO):
 - 1. ISO 9001 - Standard for Manufacturing Quality Management Systems
 - 2. ISO 14025 – Environmental Labels and Declarations -- Type III Environmental Declarations -- Principles and Procedures
 - 3. ISO14040 – Environmental Management -- Life Cycle Assessment -- Principles and Framework
 - 4. ISO 14044 – Environmental Management -- Life Cycle Assessment -- Requirements and Guidelines
 - 5. ISO 21930 – Sustainability in Buildings and Civil Engineering Works -- Core Rules For Environmental Product Declarations Of Construction Products And Services
- J. National Association of Architectural Metal Manufacturers (NAAMM):
 - 1. Metal Finishes Manual for Architectural and Metal Products.
- K. American Architectural Manufacturers Association (AAMA):
 - 1. AAMA 607.1 - Clear Anodic Finishes for Architectural Aluminum.
- L. United Nations Central Product Classification (UNCPC):
 - 1. UNCPC 4212 - Product Category Rules for Preparing an Environmental Product Declaration for Power-Operated Pedestrian Doors and Revolving Doors

1.04 DEFINITIONS

- A. Activation Device: Device that, when actuated, sends an electrical signal to the door operator to open the door.

1.05 PERFORMANCE REQUIREMENTS

- A. Provide automatic door operators capable of withstanding structural loads and thermal movements based on testing manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Operating Range: Minus 30 deg F (29 deg C) to 130 deg F (54 deg C).
- C. Opening-Force Requirements for Egress Doors: In the event power failure to the operator, swinging automatic entrance doors shall open with a manual force, not to exceed 30 lbf (133 N) to set door in motion, and not more than 15 lbf to fully open the door. Forces shall be applied at 1" (25 mm) from the latch edge of the door.
- D. Break Away Requirements: Automatic door operators provided with a breakaway device shall require no more than 50 lbf (222 N) applied at 1" (25 mm) from the latch edge of the door.

1.06 SUBMITTALS

- A. Submit listed submittals in accordance with Conditions of the Contract and Division 01 submittal procedures.
- B. Shop Drawings: Include plans, elevations, sections, details, hardware mounting heights, and attachments to other work. Indicate wiring for electrical supply.
- C. Color Samples for selection of factory-applied color finishes.
- D. Closeout Submittals: Provide the following with project close-out documents.
 - 1. Owner's Manual.
 - 2. Warranties.
- E. Reports: Based on evaluation performed by a qualified agency, for automatic door operators.
 - 1. Environmental Product Declaration.
 - 2. Evaluation Report for compliance with IBC.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative, with certificate issued by AAADM, who is trained for installation and maintenance of units required for this Project.

- B. Manufacturer Qualifications: A qualified manufacturer with a manufacturing facility certified under ISO 9001.
- C. Manufacturer shall have in place a national service dispatch center providing 24 hours a day, 7 days a week, emergency call back service.
- D. Certifications: Automatic door operators shall be certified by the manufacturer to meet performance design criteria in accordance with the following standards:
 - 1. ANSI/BHMA A156.19.
 - 2. NFPA 101.
 - 3. UL 325 Listed.
 - 4. UL 10C Listed.
 - 5. IBC 2009 and 2012.
 - 6. BOCA.
- E. Environmental Product Declaration (EPD): EPD for automatic door operators shall be certified by the manufacturer to comply with the following:
 - 1. Prepared under Product Category Rule (PCR) UNCPC 4212.
 - 2. Conform to ISO standards 14025, 14040, 14044, 21930
 - 3. Life Cycle Assessment Basis: Cradle to Gate, minimum.
- F. Source Limitations: Obtain automatic door operators through one source from a single manufacturer.
- G. Product Options: Drawings indicate sizes, profiles, and dimensional requirements of automatic entrance door assemblies and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- H. Power Operated Door Standard: ANSI/BHMA A156.19.
- I. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- J. Emergency-Exit Door Requirements: Comply with requirements of authorities having jurisdiction for swinging automatic entrance doors serving as a required means of egress.

1.08 PROJECT CONDITIONS

- A. Field Measurements: General Contractor shall verify openings to receive automatic door operators by field measurements before fabrication and indicate measurements on Shop Drawings.
- B. Mounting Surfaces: General Contractor shall verify all surfaces to be plumb, straight and secure; substrates to be of proper dimension and material.
- C. Other trades: General Contractor Advise of any inadequate conditions or equipment.

1.09 COORDINATION

- A. Templates: Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing automatic door operators to comply with indicated requirements.
- B. Electrical System Roughing-in: Coordinate layout and installation of automatic door operators with connections to, power supplies, remote activation devices, and electric door latching hardware.
- C. System Integration: Integrate automatic door operators with other systems as required for a complete working installation. Where required for proper operation, provide a time delay relay to signal automatic door operator to activate only after electric lock system is released.

1.10 WARRANTY

- A. Automatic door operators shall be free of defects in material and workmanship for a period of one (1) year from the date of substantial completion.
- B. During the warranty period the Owner shall engage a factory-trained technician to perform service and affect repairs. A safety inspection shall be performed after each adjustment or repair and a completed inspection form shall be submitted to the Owner.

- C. During the warranty period all warranty work, including but not limited to emergency service, shall be performed during normal working hours.

PART 2 PRODUCTS

2.01 AUTOMATIC DOOR OPERATORS

- A. Manufacturer: Stanley Access Technologies; Magic-Access™ Series automatic door operator.
1. No Substitutions – Facility Standard.
 2. See Door Schedule on drawings for locations.

2.02 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Headers: 6063-T6.
 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
 3. Sheet and Plate: ASTM B 209.
- B. Sealants and Joint Fillers: Refer to Division 7 Section "Joint Sealants".

2.03 COMPONENTS

- A. Header Case: Header case shall not exceed 6-1/8 inch x 4 inch (156 mm x 102 mm) in rectangular section and shall be fabricated from extruded aluminum with structurally integrated end caps, designed to conceal door operators and controls. The operator shall be sealed against dust, dirt, and corrosion within the header case. Access to the operator and electronic control box shall be provided by a full-length removable cover, edge rabbetted to the header to ensure a flush fit. Removable cover shall be secured to prevent unauthorized access.
- B. Door Arms and Linkage Assembly: A combination of door arms and linkage shall provide positive control of door through entire swing; units shall permit use of butt hung, center pivot, and offset pivot-hung doors.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
- D. Signage: Provide signage in accordance with ANSI/BHMA A156.19.

2.04 SWINGING DOOR OPERATORS

- A. General: Provide door operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.
- B. Operators: Self-contained units powered by a minimum fractional horsepower, permanent-magnet DC motors.
1. Electro-mechanical Operator: Transmit power from operator to door through reduction gear train, splined spindle, door arm, and linkage assembly. Drive train shall have positive constant engagement.
 2. Operation: Power opening and spring closing.
 3. Capacity: Rated for door panels weighing up to 125 lb (57 kg)
 4. Mounting: Visible
 5. Features:
 - a. Adjustable opening, open check, and closing speeds.
 - b. Adjustable opening force.
 - c. Adjustable hold-open time between 0 and 30 seconds.
 - d. Reverse on obstruction.
 - e. Push to operate activation.
- C. Closing Operation: The operator shall close the door by spring energy employing the motor, as a dynamic brake to provide closing speed control. The closing spring shall be adjustable for positive closing action at a low material stress level for long spring life.

- D. Manual Use: The operator shall function as a manual door closer in the direction of swing with or without electrical power. The operator shall deliver an even, consistent open force across the entire transition from door fully closed to door fully open.
- E. Electrical service to door operators shall be provided under Division 26 Electrical. Minimum service to be 120 VAC, 5 amps.

2.05 ELECTRICAL CONTROLS

- A. Electrical Control System: Electrical control system shall include a solid state controller with quick connect plugs.
- B. Controller Protection: The controller shall incorporate the following features to ensure trouble free operation:
 - 1. Main Fuse Protection.
 - 2. Electronic Surge Protection.
 - 3. Internal Power Supply Protection.
 - 4. Motor Protection, over-current protection.
- C. Program Dip Switches: The controller shall have program dip switches to allow selection or change of activation options; standard activation or push-to-operate.
- D. Power Switch: Automatic door operators shall be equipped with a two position On/Off switch to control power to the door.

2.06 ACTIVATION DEVICES

- A. Manufacturer: BEA, A HALMA Company; 10LPR36 Low Profile Push Plate automatic door actuator; www.beasensors.com; 1-800-523-2462
 - 1. No Substitutions – Facility Standard.
 - 2. See Door Schedule on drawings for locations.
- B. Push Plates: Face plates and mounting studs shall be stainless steel. Face plates shall be engraved with the international symbol for accessibility and “Push To Open”. Push plates shall be wall mounted in single or double gang electrical boxes and hardwired to door operator controls.
 - 1. Model Number: 10LPR36-HW
- C. Coordinate locations with drawings, other trades and Architect.

2.07 ALUMINUM FINISHES

- A. Comply with NAAMM Metal Finishes Manual for Architectural and Metal Products for recommendations for applying and designing finishes. Finish designations prefixed by AA comply with system established by Aluminum Association for designing finishes.
- B. Class II, Clear Anodic Finish: AA-M12C22A31 Mechanical Finish: as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.40 mils minimum complying with AAMA 611-98, and the following:
 - 1. AAMA 607.1
 - 2. Applicator must be fully compliant with all applicable environmental regulations and permits, including wastewater and heavy metal discharge.

PART 3 EXECUTION

3.01 INSPECTION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of swinging automatic entrance doors. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion. Rigidly secure non-movement joints.

- B. Mounting: Install automatic door operators/headers plumb and true in alignment with established lines and grades. Anchor securely in place.
 - 1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
 - 2. Set headers, arms and linkages level and true to location with anchorage for permanent support.
- C. Door Operators: Connect door operators to electrical power distribution system as specified in Division 26 Sections.

3.03 FIELD QUALITY CONTROL

- A. Testing Services: Factory Trained Installer shall test and inspect each swinging automatic entrance door to determine compliance of installed systems with applicable ANSI standards.

3.04 ADJUSTING

- A. Adjust door operators, controls, and hardware for smooth and safe operation, for tight closure, and complying with requirements in ANSI A156.19 by AAADM Certified Technician.

3.05 CLEANING AND PROTECTION

- A. Clean surfaces promptly after installation. Remove excess sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.

END OF SECTION

**SECTION 08 80 00
GLAZING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Insulating glass units.
- B. Glazing units.
- C. Laminated glass interlayers.
- D. Glazing compounds.

1.02 RELATED REQUIREMENTS

- A. Section 01 23 00 - Alternates: add alternate for IG-3B locations.
- B. Section 07 25 00 - Weather Barriers.
- C. Section 07 26 00 - Vapor Retarders.
- D. Section 07 27 00 - Air Barriers.
- E. Section 07 92 00 - Joint Sealants: Sealants for other than glazing purposes.
- F. Section 08 11 13 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.
- G. Section 08 41 26 - All-Glass Entrances and Storefronts: Glazing provided as part of entrance assembly.
- H. Section 08 43 13 - Aluminum-Framed Storefronts: Glazing provided as part of storefront assembly.

1.03 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. AAMA 501.6 - Recommended Dynamic Test Method for Determining the Seismic Drift Causing Glass Fallout from Window Wall, Curtain Wall and Storefront Systems; 2018.
- C. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
- D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- F. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- H. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.
- I. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- J. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.
- K. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
- L. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.
- M. GANA (SM) - GANA Sealant Manual; 2008.
- N. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- O. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.
- P. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.

- Q. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2023.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- C. Installer's qualification statement.
1. Architectural Glass and Metal Technician (AGMT) certificates or equivalent ANSI accredited certificates for architectural glass and metal installers for no less than 50% of the crew installing architectural glass and metal products.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
- B. Installer Qualifications: A qualified glazing contractor for this Project who employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program. No less than 50% of the crew performing architectural glass and metal work shall be Architectural Glass and Metal Technicians (AGMT).
- C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

1.07 MOCK-UPS

- A. See Section 01 43 39 - Mockups for additional requirements.

1.08 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 40 degrees F (4 degrees C).
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.09 WARRANTY

- A. See Section 01 77 00-Closeout Procedures for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Float Glass Manufacturers:
1. Cardinal Glass Industries: www.cardinalcorp.com/#sle.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Laminated Glass Manufacturers:
1. Cardinal Glass Industries: www.cardinalcorp.com/#sle.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Bird-Friendly Glass Manufacturers:
1. Cardinal Glass Industries: www.cardinalcorp.com/#sle.

2.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

- A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
 - 1. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
 - 2. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
 - 3. Glass thicknesses listed are minimum.
- B. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.
 - 1. In conjunction with weather barrier related materials described in other sections, as follows:
 - a. Water-Resistive Barriers: See Section 07 25 00.
 - b. Vapor Retarders: See Section 07 26 00.
 - c. Air Barriers: See Section 07 27 00.
 - 2. To utilize inner pane of multiple pane insulating glass units for continuity of vapor retarder and/or air barrier seal.
 - 3. To maintain a continuous vapor retarder and/or air barrier throughout glazed assembly from glass pane to heel bead of glazing sealant.
- C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
 - 1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
 - 2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
 - 3. Solar Optical Properties: Comply with NFRC 300 test method.

2.03 GLASS MATERIALS

- A. Float Glass: Provide float glass based glazing unless otherwise indicated.
 - 1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
 - 2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
 - 3. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
- B. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
 - 1. Laminated Safety Glass: Complies with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.

2.04 INSULATING GLASS UNITS

- A. Manufacturers:
 - 1. Cardinal Glass Industries: www.cardinalcorp.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
 - B. Insulating Glass Units: Types as indicated.
 - 1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
 - 2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO.
 - 3. Spacer Color: Black.
 - 4. Edge Seal:
 - a. Color: Black.
 - 5. Purge interpane space with dry air, hermetically sealed.
 - C. Type IG-1 - Insulating Glass Units: Vision glass, double glazed.
 - 1. Applications: Exterior glazing unless otherwise indicated.
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2. Space between lites filled with argon.
 - a. Basis of Design: Cardinal Endure IG spacer.
 - b. Basis of Design Air Gap: 1/2 inch or 13 mm.
 3. Outboard Lite: Heat-strengthened float glass, 1/4 inch or 5.77 mm thick, minimum.
 - a. Tint: Clear.
 - b. Coating: Self-cleaning type, on #1 surface.
 - c. Coating: Low-E (passive type), LoE-270 on #2 surface.
 4. Inboard Lite: Heat-strengthened float glass, 1/4 inch or 5.77 mm thick, minimum.
 - a. Tint: Clear.
 5. Total Thickness: 1 inch or 24.4 mm .
 6. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.30, nominal.
 7. Visible Light Transmittance (VLT): 68 percent, nominal.
 8. Solar Heat Gain Coefficient (SHGC): 0.41, nominal.
- D. Type IG-1B - Insulating Glass Units: Bird-friendly Acid Etched vision glass, double glazed.
1. Applications: Exterior glazing unless otherwise indicated.
 2. Space between lites filled with argon.
 - a. Basis of Design: Cardinal Endure IG spacer.
 - b. Basis of Design Air Gap: 1/2 inch or 13 mm.
 3. Outboard Lite: Heat-strengthened float glass, 1/4 inch or 5.77 mm thick, minimum.
 - a. Tint: Clear.
 - b. Bird-Friendly Pattern: 5 mm dots, spaced at 2 by 2 inches.
 - 1) Acid-etched on exterior, Surface 1, of IGU.
 - c. Coating: Low-E (passive type), LoE-270 on #2 surface.
 4. Inboard Lite: Heat-strengthened float glass, 1/4 inch or 5.77 mm thick, minimum.
 - a. Tint: Clear.
 5. Total Thickness: 1 inch or 24.4 mm .
 6. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.30, nominal.
- E. Type IG-2 - Insulating Glass Units: Vision glass, double glazed.
1. Applications: Tempered exterior glazing as indicated on drawings.
 2. Space between lites filled with argon.
 - a. Basis of Design: Cardinal Endure IG spacer.
 - b. Basis of Design Air Gap: 1/2 inch or 13 mm.
 3. Outboard Lite: Fully tempered float glass, 1/4 inch or 5.77 mm thick, minimum.
 - a. Tint: Clear.
 - b. Coating: Self-cleaning type, on #1 surface.
 - c. Coating: Low-E (passive type), LoE-270 on #2 surface.
 4. Inboard Lite: Fully tempered laminated float glass, 1/4 inch or 5.77 mm thick, minimum.
 - a. Tint: Clear.
 5. Total Thickness: 1 inch or 25.7 mm.
 6. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.30, nominal.
- F. Type IG-2B - Insulating Glass Units: Bird-friendly Acid Etched vision glass, double glazed.
1. Applications: Tempered exterior glazing as indicated on drawings.
 2. Space between lites filled with argon.
 - a. Basis of Design: Cardinal Endure IG spacer.
 - b. Basis of Design Air Gap: 1/2 inch or 13 mm.
 3. Outboard Lite: Fully tempered float glass, 1/4 inch or 5.77 mm thick, minimum.
 - a. Tint: Clear.
 - b. Bird-Friendly Pattern: 5 mm dots, spaced at 2 by 2 inches.
 - 1) Acid-etched on exterior, Surface 1, of IGU.
 - c. Coating: Low-E (passive type), LoE-270 on #2 surface.
-

4. Inboard Lite: Fully tempered float glass, 1/4 inch or 5.77 mm thick, minimum.
 - a. Tint: Clear.
 5. Total Thickness: 1 inch or 24.4 mm .
 6. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.30, nominal.
- G. Type IG-3B - Insulating Glass Units: Bird-friendly Acid Etched laminated exterior glazing.
1. Applications: See Section 01 23 00 - Alternates for locations .
 2. Space between lites filled with argon.
 - a. Basis of Design: Cardinal Endure IG spacer.
 - b. Basis of Design Air Gap: 1/2 inch or 13 mm.
 3. Outboard Lites: Heat-strengthened float glass, 1/4 inch or 5.77 mm thick, minimum.
 - a. Tint: Clear.
 - b. Bird-Friendly Pattern: 5 mm dots, spaced at 2 by 2 inches.
 - 1) Acid-etched on exterior, Surface 1, of IGU.
 - c. Coating: Low-E (passive type), LoE-270 on #2 surface.
 - d. PVB Interlayer between outboard lites (LGI-1).
 4. Inboard Lite: Heat-strengthened float glass, 1/4 inch or 5.77 mm thick, minimum.
 - a. Tint: Clear.
 5. Total Thickness: 1 inch or 24.4 mm .
 6. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.30, nominal.

2.05 BASIS OF DESIGN - INSULATING GLASS UNITS

- A. Basis of Design - Insulating Glass Units: Vision glazing, with low-e coating.
1. Applications: Exterior insulating glass glazing unless otherwise indicated.
 2. Space between lites filled with argon.
 3. Total Thickness: 1 inch or 24.4 mm.
 4. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.30, nominal.
 5. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO.
 6. Spacer Color: Black.
 7. Edge Seal:
 - a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
 8. Color: Black.
 9. Purge interpane space with dry air, hermetically sealed.

2.06 GLAZING UNITS

- A. Type G-1 - Monolithic Interior Vision Glazing:
1. Applications: Interior glazing unless otherwise indicated.
 2. Glass Type: Annealed float glass.
 3. Tint: Clear.
 4. Thickness: 1/4 inch (6.4 mm), nominal.
- B. Type G-2 - Monolithic Interior Vision Glazing:
1. Applications: Tempered interior glazing as indicated on drawings.
 2. Glass Type: Fully tempered float glass.
 3. Tint: Clear.
 4. Thickness: 1/4 inch (6.4 mm), nominal.

2.07 LAMINATED GLASS INTERLAYERS

- A. Type LGI-1 - Polyvinyl Butyral (PVB) Interlayer for Laminated Glazing:
1. Functionality: Post-breakage safety and security.

2. Applications:
 - a. Single pane, laminated glass unit.
 - b. Interior laminated pane of insulating glass unit, Type IG-3B.
3. Color: Clear.
4. Thickness: As required for indicated performance of laminated glass application.
5. Manufacturers:
 - a. Eastman Chemical Company; Saflex Clear PVB Interlayer: www.saflex.com/#sle.
 - b. Sekisui S-LEC America, LLC; S-LEC Clear Film: www.s-lec.us/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

2.08 GLASS COATINGS

- A. Decorative Coating: Two component, water-based silicone polyurethane opaque color hybrid coating for roll coat and spray applications.
 1. Application: Interior locations as indicated on drawings.
 - a. Glass and Coating Orientation: On surface facing substrate
 2. Decorative Coating Glass Unit Fabrication: Strictly according to coating manufacturer's written instructions.
 3. Dry Film Thickness: Between 0.0012 inch (0.030 mm) and 0.0015 inch (0.040 mm), minimum.
 4. Color: Selected from manufacturer's standard range and indicated on drawings.

2.09 GLAZING COMPOUNDS

- A. Type GC-1 - Glazing Putty: Polymer modified latex recommended by manufacturer for outdoor use, knife grade consistency; gray color.
- B. Type GC-2 - Butyl Sealant: Single component; ASTM C920 Grade NS, Class 12-1/2, Uses M and A, Shore A hardness of 10 to 20; black color.
- C. Type GC-3 - Polysulfide Sealant: Two component; chemical curing, nonsagging type; ASTM C920 Type M, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.
- D. Type GC-4 - Polyurethane Sealant: Single component, chemical curing, nonstaining, nonbleeding; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 20 to 35; color as selected.
- E. Type GC-5 - Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; nonbleeding, nonstaining; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.
- F. Manufacturers:
 1. Bostik Inc: www.bostik-us.com/#sle.
 2. Dow Corning Corporation: www.dowcorning.com/construction/#sle. Dow Corning Corporation: www.dowcorning.com/construction/#sle.
 3. Momentive Performance Materials, Inc: www.momentive.com/#sle.
 4. Pecora Corporation: www.pecora.com/#sle.
 5. Tremco Commercial Sealants & Waterproofing; Proglaze: www.tremcosealants.com/#sle.

2.10 ACCESSORIES

- A. Concealed nonprogressive structural glass mounting system.
 1. Glass Panel Mounting System: Two-part patented system of interlocking metal rail brackets structurally connected to substrate surface and backs of glass units for concealed support.
 - a. Applications: As indicated on drawings for wall mounted glass units.
 - 1) Include adaptations for installation where compliance with applicable seismic design is required.
 - (a) Provide system successfully tested in accordance with AAMA 501.6.
 - b. Mounting Action: Hook shape of mounting rail bracket interlocks with hook shape of another mounting bracket.

- c. Nonprogressive mounting sequence.
 - d. System Weight Supporting Capacity: Up to 84 lb/sq ft (410.0 kg/sq m) glass panel weight per unit of area, or up to 500 lb (226.8 kg) total glass panel weight.
 - e. Maximum Reveal Width Between Panel Edges: 1/4 inch (6.4 mm) at completed installation.
 - f. Manufacturers:
 - 1) McGrory Glass Inc; CaptiveHook by McGrory Glass: www.mcgrory.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
- B. Setting Blocks: Silicone, with 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) by width of glazing rabbet space minus 1/16 inch (1.5 mm) by height to suit glazing method and pane weight and area.
- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
- 1. Width: As required for application.
 - 2. Thickness: As required for application.
 - 3. Spacer Rod Diameter: As required for application.
 - 4. Manufacturers:
 - a. Pecora Corporation: www.pecora.com/#sle.
 - b. Tremco Global Sealants: www.tremcosealants.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.
- E. Glazing Clips: Manufacturer's standard type.
- F. Smoke Removal Window/Glazing Unit Markings: Adhesive backed markings affixed to manually operable or fixed windows of high-rise buildings to identify units intended for post-fire smoke removal in compliance with ICC (IBC) and local building officials.

2.11 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Provide shop inspection and testing for all types of glass.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that the minimum required face and edge clearances are being provided.
- C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.
- D. Verify that sealing between joints of glass framing members has been completed effectively.
- E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

- A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.
- B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
- C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
- D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
- E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
- F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, and paint.

3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

- A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.
- C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.05 INSTALLATION - DRY GLAZING METHOD (TAPE AND GASKET SPLINE GLAZING)

- A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.
- B. Cut glazing tape to length; install on glazing pane. Seal corners by butting tape and sealing junctions with butyl sealant.
- C. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.
- D. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
- E. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.
- F. Carefully trim protruding tape with knife.

3.06 INSTALLATION - DRY GLAZING METHOD (TAPE AND TAPE)

- A. Application - Interior Glazed: Set glazing infills from the interior of the building.
- B. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch (1.6 mm) above sight line.
- C. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.
- D. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.
- E. Place glazing tape on free perimeter of glazing in same manner described above.
- F. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
- G. Carefully trim protruding tape with knife.

3.07 INSTALLATION - WET GLAZING METHOD (COMPOUND AND COMPOUND)

- A. Application - Interior Glazed: Set glazing infills from the interior of the building.
 - B. Install glazing resting on setting blocks. Install applied stop and center pane by use of spacer shims at 24 inch (610 mm) centers, kept 1/4 inch (6 mm) below sight line.
 - C. Locate and secure glazing pane using glazers' clips.
-

- D. Fill gaps between glazing and stops with glazing compound until flush with sight line. Tool surface to straight line.

3.08 INSTALLATION - WET/DRY GLAZING METHOD (PREFORMED TAPE AND SEALANT)

- A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.
- B. Cut glazing tape to length and set against permanent stops, 3/16 inch (5 mm) below sight line. Seal corners by butting tape and dabbing with butyl sealant.
- C. Apply heel bead of butyl sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete the continuity of the air and vapor seal.
- D. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.
- E. Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact at perimeter of pane or glass unit.
- F. Install removable stops, with spacer strips inserted between glazing and applied stops 1/4 inch (6.4 mm) below sight lines.
 - 1. Place glazing tape on glazing pane of unit with tape flush with sight line.
- G. Fill gap between glazing and stop with _____ type sealant to depth equal to bite of frame on glazing, but not more than 3/8 inch (9 mm) below sight line.
- H. Apply cap bead of _____ type sealant along void between the stop and the glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.09 INSTALLATION - WET/DRY GLAZING METHOD (TAPE AND SEALANT)

- A. Application - Interior Glazed: Set glazing infills from the interior of the building.
- B. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch (1.6 mm) above sight line.
- C. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.
- D. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
- E. Install removable stops, spacer shims inserted between glazing and applied stops at 24 inch (610 mm) intervals, 1/4 inch (6 mm) below sight line.
- F. Fill gaps between pane and applied stop with specified type sealant to depth equal to bite on glazing, to uniform and level line.
- G. Carefully trim protruding tape with knife.

3.10 INSTALLATION - BUTT JOINT GLAZING METHOD (SEALANT ONLY)

- A. Application - Exterior Glazed: Set glazing infills from exterior side of building.
- B. Temporarily brace glass in position for duration of glazing process; mask edges of glass at adjoining glass edges and between glass edges and framing members.
- C. Temporarily secure a small diameter nonadhering foamed rod on back side of joint.
- D. Apply sealant to open side of joint in continuous operation; thoroughly fill joint without displacing foam rod, and then tool sealant surface smooth to concave profile.
- E. Permit sealant to cure then remove foam backer rod, and then apply sealant to opposite side, tool smooth to concave profile.
- F. Remove masking tape.

3.11 INSTALLATION - PRESSURE GLAZED SYSTEMS

3.12 INSTALLATION - STRUCTURAL SILICONE GLAZING

- A. Application - Factory (Shop) Glazed: Follow basic guidelines of structural silicone glazing for glazing application.

- B. Provide design review of the glazing system and project details, adhesion testing, proper surface preparation, training and a quality service program.
- C. Provide only structural silicone sealant, tested and manufactured for structural glazing.

3.13 INSTALLATION - ACRYLIC FOAM TAPE STRUCTURAL GLAZING

- A. Application - Factory (Shop) Glazed: Follow basic guidelines of structural silicone glazing for acrylic foam tape structural glazing application.
- B. Provide design review of the glazing system and project details, adhesion testing, proper surface preparation, training and a quality service program.
- C. Provide only acrylic foam tapes designed, tested and manufactured for structural glazing.

3.14 INSTALLATION - PLASTIC FILM

- A. Install plastic film with adhesive, applied in accordance with film manufacturer's instructions.
- B. Place without air bubbles, creases or visible distortion.
- C. Install film tight to perimeter of glass and carefully trim film with razor sharp knife. Provide 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) gap at perimeter of glazed panel unless otherwise required. Do not score the glass.

3.15 FIELD QUALITY CONTROL

- A. See Section 01 45 16-Field Quality Control Procedures for City of Madison requirements.
- B. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- C. Monitor and report installation procedures and unacceptable conditions.

3.16 CLEANING

- A. See Section 01 74 19 - Construction Waste Management and Disposal, for additional requirements.
- B. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- C. Remove nonpermanent labels immediately after glazing installation is complete.
- D. Clean glass and adjacent surfaces after sealants are fully cured.
- E. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.17 PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.
- B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

3.18 SCHEDULES

- A. See applicable schedules as indicated on the drawings.

END OF SECTION

**SECTION 08 83 00
MIRRORS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Glass mirrors.
 - 1. Annealed float glass.
- B. Stainless Steel mirrors.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Blocking and supports.

1.03 REFERENCE STANDARDS

- A. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- B. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- C. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2024.
- D. GANA (GM) - GANA Glazing Manual; 2022.
- E. GANA (SM) - GANA Sealant Manual; 2008.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Product Data on Glazing Compounds: Submit chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- D. Manufacturer's Certificate: Certify that mirrors, meets or exceeds specified requirements.
- E. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA (GM) and GANA (SM) for glazing installation methods.
- B. Fabricate, store, transport, receive, install, and clean mirrors in accordance with manufacturer's recommendations.

1.06 FIELD CONDITIONS

- A. Do not install mirrors when ambient temperature is less than 50 degrees F (10 degrees C).
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.07 WARRANTY

- A. See Section 01 77 00-Closeout Procedures for additional warranty requirements.
- B. Provide minimum five year manufacturer warranty for reflective coating on mirrors and replacement of same.

PART 2 PRODUCTS**2.01 MANUFACTURERS****2.02 MATERIALS**

- A. Mirror Glass Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.
- B. Mirror Glass: ASTM C1036, Type 1 - Transparent Flat, Class 1 - Clear, Quality - Q1 (high-quality mirrors); silvering, protective coating, and quality requirements in compliance with ASTM C1503.
 - 1. Thickness: 1/4 inch (6 mm).
 - 2. Backing: Full-mirror sized, minimum 0.03 inch (0.8 mm) galvanized steel sheet and nonabsorptive filler material.
 - 3. Size: As indicated on drawings.
 - a. Do not exceed manufacturer's recommended maximum size.
 - 4. Location: For use in all Library restrooms. See drawings.
- C. Frameless Stainless Steel; 18-8, Type 304 stainless steel.
 - 1. Thickness: 20 gauge (0.9mm).
 - 2. Finish: Polished No. 8 mirror finish.
 - 3. Edges: 1/4 inch (0.6mm) return.
 - 4. Backing: 1/4 inch tempered masonite.
 - 5. Size: As indicated on drawings.
 - a. Do not exceed manufacturer's recommended maximum size.
 - 6. Location: For all Pavilion restrooms. See Drawings.
 - 7. Basis of Design: Bobrick Model B-1556 series.
 - a. Bobrick Washroom Equipment, Inc., www.bobrick.com
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 ACCESSORIES

- A. Mirror Attachment Accessories: Tamper-proof hanging system as recommended by manufacturer.
- B. Mirror Adhesive: Silicone pre-polymer based, chemically compatible with mirror coating and wall substrate.
 - 1. Volatile Organic Content (VOC): Refer to limits in Section 01 81 13 - Sustainable Design Requirements.
- C. Rolled Formed Frame: One piece, roll-formed angle frame, stainless steel, Type 430, satin finish, with welded frame corners, ground and polished smooth.
 - 1. For use with glass mirrors.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.02 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Prepare installation in accordance with ASTM C1193 for solvent release sealants, and install sealant in accordance with manufacturer's instructions.

3.03 INSTALLATION

- A. Install mirrors in accordance with manufacturer's recommendations.
- B. Set mirrors plumb and level, and free of optical distortion.

- C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.
- D. Install mirrors per mounting height table on the drawings and per ICC A117.1.

3.04 CLEANING

- A. Remove wet glazing materials from finish surfaces.
- B. Remove labels after work is complete.
- C. Clean mirrors and adjacent surfaces.

END OF SECTION

SECTION 09 05 61
COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
 - 1. Resilient tile.
 - 2. Carpet tile.
 - 3. Thin-set ceramic tile and stone tile.
 - 4. Resinous Flooring.
- B. Preparation of new concrete floor slabs for installation of floor coverings.
- C. Testing of concrete floor slabs for moisture and alkalinity (pH).
- D. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
 - 1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
- E. Patching compound.
- F. Remedial floor coatings.
- G. Remedial floor sheet membrane.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Moisture emission reducing curing and sealing compound for slabs to receive adhered flooring, to prevent moisture content-related flooring failures; to remain in place, not to be removed.
- B. Section 03 30 00 - Cast-in-Place Concrete: Concrete admixture for slabs to receive adhered flooring, to prevent moisture content-related flooring failures.
- C. Section 03 30 00 - Cast-in-Place Concrete: Limitations on curing requirements for new concrete floor slabs.

1.03 REFERENCE STANDARDS

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens); 2021.
- B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete; 2020.
- C. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- D. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

1.04 ADMINISTRATIVE REQUIREMENTS

1.05 SUBMITTALS

- A. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
 - 1. Moisture and alkalinity (pH) limits and test methods.
 - 2. Manufacturer's required bond/compatibility test procedure.
 - B. Testing Agency's Report:
-

1. Description of areas tested; include floor plans and photographs if helpful.
 2. Summary of conditions encountered.
 3. Moisture and alkalinity (pH) test reports.
 4. Copies of specified test methods.
 5. Recommendations for remediation of unsatisfactory surfaces.
 6. Product data for recommended remedial coating.
 7. Submit report to Architect.
 8. Submit report not more than two business days after conclusion of testing.
- C. Adhesive Bond and Compatibility Test Report.
- D. Floor Moisture Testing Technician Certificate: International Concrete Repair Institute (ICRI) Concrete Slab Moisture Testing Technician- Grade I certificate.

1.06 QUALITY ASSURANCE

- A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
- B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
- C. Contractor's Responsibility Relating to Independent Agency Testing:
1. Provide access for and cooperate with testing agency.
 2. Confirm date of start of testing at least 10 days prior to actual start.
 3. Allow at least 4 business days on site for testing agency activities.
 4. Achieve and maintain specified ambient conditions.
 5. Notify Architect when specified ambient conditions have been achieved and when testing will start.
- D. Floor Moisture Testing Technician Qualifications: International Concrete Repair Institute (ICRI) Concrete Slab Moisture Testing Technician Certification- Grade I.
- E. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

1.08 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F (18 degrees C) or more than 85 degrees F (30 degrees C).
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
 - 1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
 - 2. Latex or polyvinyl acetate additions are permitted; gypsum content is prohibited.
 - 3. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
 - 4. Products:
 - a. ARDEX Engineered Cements; ARDEX Feather Finish: www.ardexamericas.com/#sle.
 - b. H.B. Fuller Construction Products, Inc; TEC Feather Edge Skim Coat: www.tecspecialty.com/#sle.
 - c. USG Corporation; Durock Brand Advanced Skim Coat Floor Patch: www.usg.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.
- C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
 - 1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
 - 2. Use product recommended by testing agency.
- D. Remedial Floor Sheet Membrane: Pre-formed multi-ply sheet membrane installed over concrete subfloor and intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
 - 1. Thickness: 28 mil (0.028 inch) (0.711 mm).
 - 2. Tape: Types recommended by underlayment manufacturer to install membrane and cover seams.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

- A. Follow recommendations of testing agency.
 - B. Perform following operations in the order indicated:
 - 1. Preliminary cleaning.
 - 2. Moisture vapor emission tests; 3 tests in the first 1000 square feet (100 square meters) and one test in each additional 1000 square feet (100 square meters), unless otherwise indicated or required by flooring manufacturer.
 - 3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 - 4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 - 5. Specified remediation, if required.
 - 6. Patching, smoothing, and leveling, as required.
-

7. Other preparation specified.
 8. Adhesive bond and compatibility test.
 9. Protection.
- C. Remediations:
1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
 2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
 3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.02 PRELIMINARY CLEANING

- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
- B. Do not use solvents or other chemicals for cleaning.

3.03 MOISTURE VAPOR EMISSION TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet (1.4 kg per 93 square meters) per 24 hours.
- F. Report: Report the information required by the test method.

3.04 INTERNAL RELATIVE HUMIDITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F2170 Procedure A and as follows.
- D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
- F. Report: Report the information required by the test method.

3.05 ALKALINITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.06 PREPARATION

- A. See individual floor covering section(s) for additional requirements.
- B. Comply with recommendations of testing agency.
- C. Comply with requirements and recommendations of floor covering manufacturer.
- D. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- E. Do not fill expansion joints, isolation joints, or other moving joints.

3.07 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. Comply with requirements and recommendations of floor covering manufacturer.

3.08 APPLICATION OF REMEDIAL FLOOR COATING

- A. Comply with requirements and recommendations of coating manufacturer.

3.09 INSTALLATION OF REMEDIAL FLOOR SHEET MEMBRANE

- A. Install in accordance with sheet membrane manufacturer's instructions.

3.10 PROTECTION

- A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Resilient sound isolation clips.
- C. Acoustic insulation.
- D. Gypsum sheathing.
- E. Cementitious backing board.
- F. Gypsum wallboard.
- G. Joint treatment and accessories.
- H. Textured finish system.

1.02 RELATED REQUIREMENTS

- A. Section 05 40 00 - Cold-Formed Metal Framing: Structural steel stud framing.
- B. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
- C. Section 07 25 00 - Weather Barriers: Water-resistive barrier over sheathing.
- D. Section 07 84 00 - Firestopping: Top-of-wall assemblies at fire-resistance-rated walls.
- E. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.
- F. Section 08 31 00 - Access Doors and Panels: openings in drywall partitions and ceilings.
- G. Section 09 22 16 - Non-Structural Metal Framing.

1.03 REFERENCE STANDARDS

- A. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.
- B. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).
- C. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2018.
- D. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2019.
- E. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.
- F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- G. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.
- H. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).
- I. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- J. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2020.
- K. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.

- L. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
- M. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing; 2018 (Reapproved 2023).
- N. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022, with Editorial Revision (2023).
- O. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- P. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- Q. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.
- R. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
- S. ASTM E413 - Classification for Rating Sound Insulation; 2022.
- T. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- U. GA-216 - Application and Finishing of Gypsum Panel Products; 2021.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the installation of gypsum board assemblies with size, location, and installation of service utilities.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- C. Sequencing: Install service utilities in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- B. Documents at Project Site: Maintain at the project site a copy of manufacturer's instructions, erection drawings, and shop drawings.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.
- C. Store metal products to prevent corrosion.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
 - 1. Acoustic Attenuation: STC as indicated calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- C. Grid Suspension Systems: Provide grid suspension systems in accordance with ASTM C840 and GA-216.

- D. Fire-Resistance-Rated Assemblies: Provide completed assemblies with the following characteristics:
1. Fire-Resistance-Rated Partitions: UL listed assemblies as indicated on the drawings.

2.02 METAL FRAMING MATERIALS

- A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.
1. Structural Grade: As required to meet design criteria.
- B. Manufacturers - Metal Framing, Connectors, and Accessories:
1. ClarkDietrich: www.clarkdietrich.com/#sle.
 2. Jaimes Industries: www.jaimesind.com/#sle.
 3. MarinoWARE: www.marinoware.com/#sle.
 4. Phillips Manufacturing Co: www.phillipsmfg.com/#sle.
 5. R-stud: www.rstud.com/#sle.
 6. SCAFCO Corporation: www.scafco.com/#sle.
 7. Steel Construction Systems: www.steelconsystems.com/#sle.
 8. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf (L/120 at 240 Pa).
1. Studs: C-shaped with knurled or embossed faces.
 2. Runners: U shaped, sized to match studs.
 3. Resilient Furring Channels: Single or double leg configuration; 1/2 inch (13 mm) channel depth.
 4. Resilient Sound Isolation Clips: Steel resilient clips with molded rubber isolators, attaches to framing; improves noise isolation performance of wall and floor-ceiling assemblies.
- D. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.
- E. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.
1. Products:
 - a. ClarkDietrich; BlazeFrame Firestop Deflection Track: www.clarkdietrich.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
1. American Gypsum Company: www.americangypsum.com/#sle.
 2. CertainTeed Corporation: www.certainteed.com/#sle.
 3. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
 4. Gold Bond Building Products, LLC provided by National Gypsum Company: www.goldbondbuilding.com/#sle.
 5. PABCO Gypsum: www.pabco gypsum.com/#sle.
 6. USG Corporation: www.usg.com/#sle.
 7. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Use for interior vertical surfaces and ceilings, unless otherwise indicated.
 2. Thickness:
 - a. Vertical Surfaces: 5/8 inch (16 mm).
- C. Backing Board For Wet Areas:

1. Application: Interior surfaces behind tile in wet areas including shower surrounds and shower ceilings.
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 3. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
 - a. Thickness: 1/2 inch (13 mm).
 4. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
 - a. Regular Type: Thickness 5/8 inch (16 mm).
 - b. Fire-Resistance-Rated Type: Type X core, thickness 5/8 inch (16 mm).
- D. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
1. Application: All GWB locations unless specified otherwise. See Drawings..
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 4. Type: Regular, Type X, and moisture resistant, in locations indicated.
 5. Type X Thickness: 5/8 inch (16 mm).
 6. Regular Board Thickness: 5/8 inch (16 mm).
 7. Edges: Tapered.
- E. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Interior Ceilings, unless otherwise indicated.
 2. Thickness: 5/8 inch (16 mm).
 3. Edges: Tapered.
- F. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
1. Application: Exterior sheathing, unless otherwise indicated.
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 3. Fungal Resistance: No fungal growth when tested in accordance with ASTM G21.
 4. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
 5. Core Type: Regular and Type X, as indicated.
 6. Type X Thickness: 5/8 inch (16 mm).
 7. Regular Board Thickness: 1/2 inch (13 mm) 5/8 inch (16 mm).
 8. Edges: Square.
- G. Exterior Soffit Board: Exterior gypsum soffit board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings and soffits in protected exterior areas, unless otherwise indicated.
 2. Types: Type X, in locations indicated.
 3. Type X Thickness: 5/8 inch (16 mm).
 4. Edges: Tapered.

2.04 GYPSUM BOARD ACCESSORIES

- A. Sound Isolation Tape: Elastomeric foam tape for sound decoupling.
1. Surface Burning Characteristics: Provide assemblies with flame spread index of 75 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 2. Tape Thickness: 1/4 inch (6 mm).
 3. Products:
 - a. Armacell LLC; ArmaComfort MTD: www.armacell.us/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

- B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
 - 1. Products:
 - a. Franklin International, Inc; Titebond Acoustical Smoke & Sound Sealant: www.titebond.com/#sle.
 - b. Liquid Nails, a brand of PPG Architectural Coatings: www.liquidnails.com/#sle.
 - c. Specified Technologies Inc; Smoke N Sound Acoustical Sealant: www.stifirestop.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Water-Resistive Barrier: See Section 07 25 00.
- D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
 - 1. Fiberglass Tape: 2 inch (50 mm) wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
 - 2. Paper Tape: 2 inch (50 mm) wide, creased paper tape for joints and corners, except as otherwise indicated.
 - 3. Joint Compound: Drying type, vinyl-based, ready-mixed.
 - 4. Joint Compound: Setting type, field-mixed.
- E. Finishing Compound: Surface coat and primer, takes the place of skim coating.
- F. High Build Drywall Surfer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.
- G. Concrete Cover Coat Compound: Ready-mix compound for filling and smoothing interior, above-grade, monolithic concrete ceilings and columns.
- H. Textured Finish Materials: Latex-based compound; plain.
- I. Glass-Fiber-Reinforced Gypsum Access Panels: Wall- and ceiling-mounted; natural white color, smooth finish, square corners.
 - 1. Material: Glass-fiber-reinforced gypsum cement.
 - 2. Exposed fasteners: Stainless steel.
 - 3. Class A flame spread rating in accordance with ASTM E84.
- J. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.
- K. Exterior Soffit Vents: One piece, perforated, ASTM B221 6063 T5 alloy aluminum, with edge suitable for direct application to gypsum board and manufactured especially for soffit application. Provide continuous vent.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION

- A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
- B. Shaft Wall Liner: Cut panels to accurate dimensions and install sequentially between special friction studs.

3.03 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C1007/AISI S220 and manufacturer's instructions.
- B. Studs: Space studs at 16 inches on center (at 406 mm on center).
 - 1. Extend partition framing to structure where indicated and to ceiling in other locations.
 - 2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.

3. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.

3.04 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Sound Isolation Tape: Apply to vertical studs and top and bottom tracks/runners in accordance with manufacturer's instructions.
- C. Acoustic Sealant: Install in accordance with manufacturer's instructions.

3.05 BOARD INSTALLATION

- A. Paper Faced gypsum board shall be installed after building is confirmed to be weather-tight and not before.
- B. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- C. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- D. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
 1. Paper-Faced Sheathing: Immediately after installation, protect from weather by application of water-resistive barrier.
- E. Exterior Soffits: Install exterior soffit board perpendicular to framing, with staggered end joints over framing members or other solid backing.
- F. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

3.06 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Exterior Soffit Vents: Install according to manufacturer's written instructions and in locations indicated on drawings. Provide vent area specified.

3.07 JOINT TREATMENT

- A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 1. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).
- C. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

3.08 TEXTURE FINISH

- A. Apply finish texture coating by means of spraying apparatus in accordance with manufacturer's instructions and in accordance with the drawings.

3.09 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

3.10 CLEANING

- A. See Section 01 77 00-Closeout Procedures. for additional requirements.

3.11 PROTECTION

- A. Protect installed gypsum board assemblies from subsequent construction operations.

END OF SECTION

SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal partition, ceiling, and soffit framing.
- B. Framing accessories.

1.02 RELATED REQUIREMENTS

- A. Section 05 40 00 - Cold-Formed Metal Framing: Requirements for structural, load-bearing, metal stud framing and exterior wall stud framing.
- B. Section 05 40 00 - Cold-Formed Metal Framing: Execution requirements for anchors for attaching work of this section.
- C. Section 06 10 00 - Rough Carpentry: Wood blocking within stud framing.
- D. Section 06 10 00 - Rough Carpentry: Wall sheathing.
- E. Section 07 21 00 - Thermal Insulation: Acoustic insulation.
- F. Section 07 84 00 - Firestopping: Sealing top-of-wall assemblies at fire-resistance-rated walls.
- G. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.
- H. Section 08 31 00 - Access Doors and Panels.

1.03 REFERENCE STANDARDS

- A. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- D. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.
- E. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
- F. ASTM E413 - Classification for Rating Sound Insulation; 2022.
- G. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.
- C. Sustainable Design Submittal: Documentation of recycled content and location of manufacture.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.
- B. Manufacturer Qualifications: Member of Steel Stud Manufacturers Association (SSMA): www.ssma.com/#sle.

1.06 MOCK-UPS

- A. See Section 01 43 39 - Mockups for requirements.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Metal Framing, Connectors, and Accessories:
 - 1. CEMCO: www.cemcosteel.com/#sle.
 - 2. ClarkDietrich: www.clarkdietrich.com/#sle.
 - 3. Jaimes Industries: www.jaimesind.com/#sle.
 - 4. MarinoWARE: www.marinoware.com/#sle.
 - 5. R-stud: www.rstud.com/#sle.
 - 6. SCAFCO Corporation: www.scafco.com/#sle.
 - 7. Simpson Strong Tie: www.strongtie.com/#sle.
 - 8. Steel Construction Systems: www.steelconsystems.com/#sle.
 - 9. Super Stud Building Products, Inc: www.buysuperstud.com/#sle.
 - 10. The Steel Network, Inc: www.SteelNetwork.com/#sle.
 - 11. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 FRAMING MATERIALS

- A. Fire-Resistance-Rated Assemblies: Comply with applicable code and as follows:
 - 1. Fire-Resistance-Rated Partitions: Listed assembly by UL as indicated on the drawings.
- B. Loadbearing Studs: As specified in Section 05 40 00.
- C. Non-Loadbearing Framing System Components: AISI S220; sheet steel, of size and properties necessary for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf (L/240 at 240 Pa).
 - 1. Studs: C-shaped with flat faces.
 - 2. Runners: U-shaped, sized to match studs.
- D. Steel Framing Stud and Track Wall System: Self-locking steel studs and telescoping stud extensions and tracks.
 - 1. Products:
 - a. ClarkDietrich; TRAKLOC Drywall Framing System: www.clarkdietrich.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Partition Head to Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and braced with continuous bridging on both sides.
- F. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.
- G. Preformed Top Track Firestop Seal:
- H. Non-Loadbearing Framing Accessories:
 - 1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
 - 2. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
 - 3. Bracing and Bridging: ASTM A653/A653M G90 galvanized steel; for lateral bracing of wall studs with slots for engaging on-module studs.
 - 4. Framing Connectors: ASTM A653/A653M steel clips; secures cold rolled channel to wall studs for lateral bracing.
 - 5. Sheet Metal Backing: 0.0395 inch (1.01 mm) thick.
 - 6. Fasteners: ASTM C1002 self-piercing self-tapping screws.
 - 7. Anchorage Devices: Powder actuated.
 - 8. Acoustic Insulation: See Section 07 21 00.
 - 9. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.

10. Touch-Up Primer for Corrosion Protected Surfaces: SSPC-Paint 20 Type I - Inorganic.

2.03 FABRICATION

- A. Fabricate assemblies of framed sections to sizes and profiles required.
- B. Fit, reinforce, and brace framing members to suit design requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that rough-in utilities are in proper location.

3.02 INSTALLATION OF STUD FRAMING

- A. Extend partition framing to structure where indicated and to ceiling in other locations.
- B. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
- C. Align and secure top and bottom runners at 24 inches (600 mm) on center.
- D. At partitions indicated with an acoustic rating:
 - 1. Provide components and install as required to produce STC ratings as indicated, based on published tests by manufacturer conducted in accordance with ASTM E90 with STC rating calculated in accordance with ASTM E413.
 - 2. Place one bead of acoustic sealant between runners and substrate , studs and adjacent construction.
 - 3. Place one bead of acoustic sealant between studs and adjacent vertical surfaces.
 - 4. Sound Isolation Tape: Apply to vertical studs and top and bottom tracks/runners in accordance with manufacturer's instructions.
- E. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- F. Install studs vertically at 16 inches (400 mm) on center.
- G. Align stud web openings horizontally.
- H. Secure studs to tracks using crimping method. Do not weld.
- I. Fabricate corners using a minimum of three studs.
- J. Install double studs at wall openings, door and window jambs, not more than 2 inches (50 mm) from each side of openings.
- K. Coordinate erection of studs with requirements of door frames; install supports and attachments.
- L. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.
- M. Blocking: Use wood blocking secured to studs. Provide blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, and opening frames.
- N. Furring: Install at spacing and locations shown on drawings. Lap splices a minimum of 6 inches (150 mm).

3.03 CEILING AND SOFFIT FRAMING

- A. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
- B. Install furring independent of walls, columns, and above-ceiling work.
- C. Securely anchor hangers to structural members or embed them in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.
- D. Space main carrying channels at maximum 72 inches (1 800 mm) on center, and not more than 6 inches (150 mm) from wall surfaces. Lap splice securely.

- E. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.
- F. Place furring channels perpendicular to carrying channels, not more than 2 inches (50 mm) from perimeter walls, and rigidly secure. Lap splices securely.

3.04 TOLERANCES

- A. Maximum Variation From True Position: 1/8 inch in 10 feet (3 mm in 3 m).
- B. Maximum Variation From Plumb: 1/8 inch in 10 feet (3 mm in 3 m).

END OF SECTION

**SECTION 09 30 00
TILING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Ceramic accessories.
- D. Non-ceramic trim.

1.02 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.
- B. Section 07 95 13 - Expansion Joint Cover Assemblies: Expansion joint components.
- C. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing; remediation procedures.
- D. Section 09 21 16 - Gypsum Board Assemblies: Tile backer board.
- E. Section 22 40 00 - Plumbing Fixtures: Shower receptor.

1.03 REFERENCE STANDARDS

- A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2017 (Reaffirmed 2022).
- B. ANSI A108.1b - Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
- C. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
- D. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive; 2023.
- E. ANSI A108.5 - Setting of Ceramic Tile with Dry-Set Cement Mortar, Modified Dry-Set Cement Mortar, EGP (Exterior Glue Plywood) Modified Dry-Set Cement Mortar, or Improved Modified Dry-Set Cement Mortar; 2023.
- F. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy; 2023.
- G. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 2023.
- H. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2017 (Reaffirmed 2022).
- I. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2018.
- J. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2020.
- K. ANSI A108.20 - American National Standard Specifications for Exterior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs; 2020.
- L. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2019.

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- M. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2021.
 - N. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation; 2019.
 - O. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation; 2019.
 - P. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2019.
 - Q. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2014 (Reaffirmed 2019).
 - R. ANSI A118.11 - American National Standard Specifications for EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar; 2017.
 - S. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014 (Reaffirmed 2019).
 - T. ANSI A118.13 - American National Standard Specification for Bonded Sound Reduction Membranes for Thin-Set Ceramic Tile Installation; 2014 (Reaffirmed 2019).
 - U. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar; 2019.
 - V. ANSI A136.1 - American National Standard Specifications for Organic Adhesives for Installation of Ceramic Tile; 2020.
 - W. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
 - X. ANSI A137.2 - American National Standard Specifications for Glass Tile; 2022.
 - Y. ANSI A137.3 - American National Standard Specifications for Gauged Porcelain Tile and Gauged Porcelain Tile Panels/Slabs; 2021.
 - Z. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.
 - AA. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
 - BB. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018 (Reapproved 2023).
 - CC. ASTM E492 - Standard Test Method for Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine; 2022.
 - DD. ASTM E2179 - Standard Test Method for Laboratory Measurement of the Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors; 2021.
 - EE. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
 - FF. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
 - GG. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
 - HH. ICC-ES AC308 - Acceptance Criteria for Termite Physical Barrier Systems; 2021, with Editorial Revision (2022).
 - II. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2023.
 - JJ. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship 2019.
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1.04 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meeting: Convene a pre-installation meeting one week before starting work of this section; require attendance by affected installers

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop Drawings: Indicate tile layout; patterns; color arrangement; perimeter conditions; junctions with dissimilar materials; control and expansion joints; thresholds; ceramic accessories; setting details.
- D. Samples: Provide two of each type indicated.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Master Grade Certificate: Submit for each type of tile, signed by the tile manufacturer and tile installer.
- G. Installer's Qualification Statement:
 - 1. Submit documentation of National Tile Contractors Association (NTCA) or Tile Contractors' Association of America (TCAA) accreditation.
 - 2. Submit documentation of completion of apprenticeship and certification programs.
 - 3. Submit documentation of Natural Stone Institute Accreditation.
- H. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Tile: 5 percent of each type, size, color, and surface finish combination

1.06 QUALITY ASSURANCE

- A. Maintain one copy of ANSI A108/A118/A136 and TCNA (HB) on site.
- B. Installer Qualifications:
 - 1. Company specializing in performing tile installation, with minimum of five years of documented experience.
 - 2. Installer Certification:
 - a. Ceramic Tile Education Foundation (CTEF): Certified Tile Installer (CTI).
 - b. Apprenticeship Program: Installer has achieved Journey-worker status through an apprenticeship from the International Union of Bricklayers and Allied Craft-workers (IUBAC) or a U.S. Department of Labor (DOL)-recognized program.
 - c. International Masonry Training and Education Foundation (IMTEF): Supervisor Certification Program (SCP).

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature above 50 degrees F (10 degrees C) during installation and curing of setting materials.

PART 2 PRODUCTS**2.01 TILE**

- A. Manufacturers: All products of each type by the same manufacturer.
 - 1. Substitutions: Not permitted.
-

- B. Glazed Wall Tile.
 - 1. Size: As indicated on the drawings.
 - 2. Surface finish as indicated on drawings.
 - 3. Color(s): As indicated on drawings.
 - 4. Pattern: As indicated on drawings.
 - 5. Products
 - a. Virginia Tile Wow USA Duo.
 - b. Ceramic Tileworks Craft, Village, Up, Small.
 - c. Substitutions: Not permitted.
- C. Porcelain Floor Tile.
 - 1. Size: As indicated on the drawings.
 - 2. Thickness: 3/8 inch.
 - 3. Edges: Square (Rectified).
 - 4. Surface Finish: UPS.
 - 5. Color: As indicated on drawings.
 - 6. Pattern: 1/3 lap.
 - 7. Products:
 - a. Crossville Argent.
 - b. Substitutions: Not permitted.
- D. Porcelain Wall Tile.
 - 1. Size: As indicated on the drawings.
 - 2. Thickness: 3/8 inch.
 - 3. Edges: Square (Rectified).
 - 4. Surface Finish: UPS.
 - 5. Color: As indicated on drawings.
 - 6. Pattern: As indicated on drawings.
 - 7. Products:
 - a. Ceramic Tileworks; Symmetry.
 - b. Crossville; Native Metal.
 - c. Substitutions: Not permitted.
- E. Mosaic Wall Tile.
 - 1. Type: Curve Chevron.
 - 2. Size: As indicated on drawings.
 - 3. Finish: Gloss.
 - 4. Color(s): Jade.
 - 5. Pattern: As indicated on drawings.
 - 6. Products:
 - a. Virginia Tile: Walker Zanger 6th Ave.
 - b. Substitutions: Not permitted.

2.02 TRIM AND ACCESSORIES

- A. Non-Ceramic: Satin natural anodized extruded aluminum.
 - 1. Application: End Cap and Outside Corners
 - a. Product: Schluter Systems Jolly.
 - b. Size: As necessary for the tile/application.
 - 2. Application: Tile to carpet flooring transitions.
 - a. Product: Schluter Systems Schiene.
 - b. Size: As necessary for the tile/application.
 - 3. Application: Floor to wall transitions.
 - a. Product: Schluter Systems DILEX-EHK & AHKA.

- b. Size: As necessary for the tile/application.
- 4. Installation: Set with tile mortar or adhesive.
- 5. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 SETTING MATERIALS

- A. Provide setting and grout materials from same manufacturer.
- B. Manufacturers:
 - 1. Basis of Design: LATICRETE International.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Improved Latex-Portland Cement Mortar Bond Coat: ANSI A118.15.
 - 1. Applications: Use this type of bond coat where indicated, and where no other type of bond coat is indicated.
 - 2. Products:
 - a. Basis of Design: LATICRETE International, Inc; MULTIMAX LITE.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 GROUTS

- A. Provide setting and grout materials from same manufacturer.
- B. Manufacturers:
 - 1. Basis of Design: LATICRETE International, Inc.
 - a. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
 - 1. Applications: Use this type of grout where indicated.
 - 2. Color(s): As selected by Architect from manufacturer's full line.
 - 3. Products:
 - a. SPECTRALOCK Pro.

2.05 ACCESSORY MATERIALS

- A. Manufacturers:
 - 1. Basis of Design: LATICRETE International.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; intended as waterproofing.
 - 1. Crack Resistance: No failure at 1/8 inch (3.2 mm).
 - 2. Fluid or Trowel Applied Type:
 - a. Material: Synthetic rubber; Acrylic.
 - b. Thickness: 20 mils (0.5 mm).
 - c. Product: HydroBAN.
- C. Tile Underlayment: Specifically designed for bonding to thin-set setting mortar; not primarily waterproofing material and having the following characteristics:
 - 1. Sound Reduction: Comply with ANSI A118.13; ASTM E492; ASTM E2179
 - 2. Crack Resistance: No failure at 1/8-inch (3.2 mm) inch gap, minimum; comply with ANSI A118.12
 - 3. Water Resistance: Comply with ANSI A118.10, bonded waterproofing.
 - 4. Termite Resistance: 100 percent when tested in accordance with ICC-ES AC380.
 - 5. Suitable for installation over green concrete.
 - 6. Type: Fluid or trowel applied.
 - a. Products:
 - 1) LATICRETE International, Inc; Level Plus.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.
- D. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
 - 1. Test in accordance with Section 09 05 61.
 - 2. Test as Follows:
 - a. Alkalinity (pH): ASTM F710.
 - b. Internal Relative Humidity: ASTM F2170.
 - c. Moisture Vapor Emission: ASTM F1869.
 - 3. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.
 - 4. Follow moisture and alkalinity remediation procedures in Section 09 05 61.
- E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.
- E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.03 INSTALLATION - GENERAL

- A. Install tile and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.20, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases; Align floor, base, and wall joints.; Align floor and wall joints
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square; and external angles square
- F. Install ceramic accessories rigidly in prepared openings.
- G. Install non-ceramic trim in accordance with manufacturer's instructions.
- H. Install thresholds where indicated.
- I. Sound tile after setting. Replace hollow sounding units.
- J. Keep control and expansion joints free of mortar, grout, and adhesive.
- K. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- L. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.

- M. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

- A. Over interior; concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat; F116, organic adhesive; with standard grout unless otherwise indicated.
1. Use uncoupling membrane under all tile unless other underlayment is indicated.
 2. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122, with latex-Portland cement grout.
 3. Where epoxy bond coat and grout are indicated, install in accordance with TCNA (HB) Method F131.
 4. Where furan bond coat and grout are indicated, install in accordance with TCNA (HB) Method F133.
 5. Where epoxy or furan grout is indicated, but not epoxy or furan bond coat, install in accordance with TCNA (HB) Method F115.

3.05 INSTALLATION - WALL TILE

- A. Over gypsum wallboard on wood or metal studs install in accordance with TCNA (HB) Method W243, thin-set with dry-set or latex-Portland cement bond coat; W223, thin-set with organic adhesive.
1. Where mortar bed is indicated, install in accordance with TCNA (HB) Method W222, one coat method.
 2. Where waterproofing membrane is indicated other than at showers and bathtub walls, install in accordance with TCNA (HB) Method W222, one coat method.
- B. Over interior concrete and masonry install in accordance with TCNA (HB) Method W202, thin-set with dry-set or latex-Portland cement bond coat, W211, bonded mortar bed without membrane.

3.06 CLEANING AND MAINTENANCE

- A. Clean tile and grout surfaces.

3.07 PROTECTION

- A. Do not permit traffic over finished floor surface 4 days after installation.

3.08 SCHEDULE

- A. As indicated on the drawings.

END OF SECTION

**SECTION 09 51 00
ACOUSTICAL CEILINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 09 21 16 - Gypsum Board Assemblies.
- C. Section 09 22 16 - Non-Structural Metal Framing.

1.03 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; 2023.
- B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- C. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.
- D. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.
- E. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- F. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2022.
- G. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning.
- C. Product Data: Provide data on suspension system components and acoustical units.
- D. Samples: Submit two samples 6 by 6 inch (15.24 by 15.24 cm) in size illustrating material and finish of acoustical units.
- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.06 QUALITY ASSURANCE

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

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

1.07 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acoustic Tiles/Panels:
1. Armstrong World Industries, Inc www.armstrongceilings.com/#sle.
 - a. Basis of Design for ACT-1
 2. Certainteed Architectural: www.certainteed.com/ceilings-and-walls/#sle.
 - a. Basis of Design for ACT-2
 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Suspension Systems:
1. Armstrong World Industries, Inc: www.armstrongceilings.com/#sle.
 - a. Basis of Design for use with ACT-1 and CLD2
 2. Certainteed Architectural: www.certainteed.com/ceilings-and-walls/#sle.
 - a. Basis of Design for use with ACT-2
 3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Rating: Determined in accordance with test procedures in ASTM E119 and complying with the following:
1. UL (FRD) Assembly as indicated on the drawings.

2.03 ACOUSTICAL UNITS

- A. Acoustical Units - General: ASTM E1264, Class A.
1. VOC Content: As specified in Section 01 61 16.
- B. Acoustical Tiles, Type ACT-1: Glass fiber with membrane-faced overlay, with the following characteristics:
1. NRC Range: {CH#107914}, determined in accordance with ASTM E1264.
 2. Application(s): General Areas - primary ceiling type.
 3. Classification: ASTM E1264 Type XII.
 - a. Form: 2, cloth.
 - b. Pattern: "E" - lightly textured.
 4. Size: 24 by 24 inches (610 by 610 mm).
 5. Thickness: 1 inch (25 mm).
 6. Light Reflectance: 0.88 percent, determined in accordance with ASTM E1264.
 7. NRC Range: 0.95, determined in accordance with ASTM E1264.
 8. Articulation Class (AC): 190, determined in accordance with ASTM E1264.
 9. Tile Edge: Square Tegular 15/16 inch.
 10. Color: As indicated on drawings.
 11. Products:
 - a. Armstrong World Industries, Inc; Optima: www.armstrongceilings.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Acoustical Tiles, Type ACT-2: Glass fiber with membrane-faced overlay, with the following characteristics:
1. Classification: ASTM E1264 Type XII.
 - a. Form: 2, cloth.

- b. Pattern: "E" - lightly textured.
2. Size: 24 by 24 inches (610 by 610 mm).
3. Thickness: 1 inch (25 mm).
4. Light Reflectance: 0.90 percent, determined in accordance with ASTM E1264.
5. NRC Range: 0.95, determined in accordance with ASTM E1264.
6. Tile Edge: Narrow Reveal, 9/16 inch.
7. Color: As indicated on drawings.
 - a. Do not paint tile in place. Remove tile from grid before painting.
8. Suspension System Type GRD-2: Exposed.
9. Products:
 - a. Certaineed Architectural; Symphony f: www.certaineed.com/ceilings-and-walls/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 SUSPENSION SYSTEM(S)

- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
 1. Materials:
 - a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.
 - b. Aluminum Grid: Aluminum sheet, ASTM B209/B209M.
- B. Exposed Suspension System, Type GRD-1: Hot-dipped galvanized steel grid with steel cap.
 1. Application(s): For use with ACT-1.
 2. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
 3. Profile: Tee; 15/16 inch (24 mm) face width.
 4. Finish: Baked enamel.
 5. Color: White (ACT-1).
 6. Products:
 - a. Armstrong World Industries, Inc; PRELUDE XL or PRELUDE XL HRC: www.armstrongceilings.com/#sle.
- C. Exposed Suspension System, Type GRD-2: Hot-dip galvanized steel grid and cap.
 1. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
 2. Products:
 - a. Certaineed Architectural; 9/16" EZ Stab Elite Narrow System: www.certaineed.com/ceilings-and-walls/#sle.
- D. Exposed Suspension System for "Cloud" Applications, Type CLD2: Galvanized steel grid and cap; trim as specified under Accessories.
 1. FORMATIONS Curves Cloud Kit
 2. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
 3. Profile: Tee; 15/16 inch (24 mm) face width. PRELUDE XL or PRELUDE XL HRC
 4. Finish: Baked enamel.
 5. Trim: AXIOM Vector for FORMATIONS Curve Clouds, 6 inch height, Inverted
 6. Color: As indicated on drawings for Cloud-2 (open grid).
 7. Products:
 - a. Armstrong World Industries, Inc; PRELUDE XL or PRELUDE XL HRC: www.armstrongceilings.com/#sle.

2.05 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.

- B. Hanger Wire: 12 gauge, 0.08 inch (2 mm) galvanized steel wire.
- C. Hold-Down Clips: Manufacturer's standard clips to suit application (entry and vestibule areas).
- D. Perimeter Moldings: Same metal and finish as grid.
 - 1. Size: As required for installation conditions.
 - 2. Angle Molding: L-shaped, for mounting at same elevation as face of grid.
 - 3. Channel Molding: U-shaped, for hold-down type installations.
- E. Metal Edge Trim for Suspension Systems: Steel or extruded aluminum; provide attachment clips, splice plates, and preformed corner pieces for complete trim system.
 - 1. Axiom for Vector Curved Perimeter Trim, Inverted at CLD-2
 - a. Trim Height: 6 inch (152 mm).
 - b. Finish: Baked enamel.
 - c. Color: As indicated on drawings for Cloud-2 (open grid).
 - d. Products:
 - 1) Armstrong World Industries, Inc; FORMATIONS / PRELUDE XL:
www.armstrongceilings.com/#sle.
 - 2. Terminus Semi-Concealed Perimeter Trim, Inverted at Cloud-1
 - a. Trim Height: 6 inch (152 mm).
 - b. Finish: Baked enamel.
 - c. Color: As indicated on drawings for Cloud-1 used with ACT-2.
 - d. Products:
 - 1) Certainteed Architectural Terminus: www.certainteed.com/ceilings-and-walls/#sle.
- F. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.02 PREPARATION

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.
- C. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

3.03 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Install in bed of acoustical sealant.
 - 2. Use longest practical lengths.
- D. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- E. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- F. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

- G. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.
- H. Do not eccentrically load system or induce rotation of runners.

3.04 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- E. Cutting Acoustical Units:
 - 1. Cut to fit irregular grid and perimeter edge trim.
 - 2. Make field cut edges of same profile as factory edges.
 - 3. Double cut and field paint exposed reveal edges.
- F. Install hold-down clips on panels within 20 ft (6 m) of an exterior door.

3.05 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.06 CLEANING

- A. See Section 01 77 00-Closeout Procedures for additional requirements.
- B. Clean surfaces.
- C. Replace damaged or abraded components, including tiles.

END OF SECTION

SECTION 09 51 26
VENEERED WOOD CEILING PANELS: WOODWORKS GRILLE - FORTÉ

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.02 SUMMARY

- A. Section Includes:
1. WoodWorks Grille-Forté Veneered Wood Ceiling Panels with Centered Notched and Flat Backers
 2. Exposed grid suspension system.
 3. Wire hangers, fasteners, main runners, cross tees, wall angle moldings and accessories.
- B. Related Sections:
1. Section 09 51 00 - Acoustical Ceilings
 2. Section 09 21 16 - Gypsum Board Assemblies
 3. Section 09 22 16 - Non-Structural Metal Framing
 4. Division 23 - HVAC
 5. Division 26 - Electrical Work

1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM):
1. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 2. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
 3. ASTM A 1008 Standard Specification for Steel, Sheet, and Cold Rolled Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 4. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
 5. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
 6. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.
 7. ASTM E 580 Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Seismic Restraint.
 8. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 9. ASTM E 1264 Classification for Acoustical Ceiling Products.
 10. Hardwood Plywood & Veneer Association (HPVA)
 11. International Building Code
 12. ASHRAE Standard 62.1-2004 Ventilation for Acceptable Indoor Air Quality
 13. NFPA 70 National Electrical Code
 14. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures
 15. International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components
 16. International Code Council-Evaluation Services Report - Seismic Engineer Report
 - a. ESR 1308 - Armstrong T-Bar or Dimensional Suspension
 17. California Air Resources Board (CARB) compliant
 18. LEED - Leadership in Energy and Environmental Design is a set of rating systems for the design, construction, operation, and maintenance of green buildings

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Shop Drawings: Layout and details of ceilings. Show locations of items that are to be coordinated with or supported by the ceilings.
- C. Installation Instructions: Submit manufacturer's installation instructions as referenced in Part three, Installation.
- D. Product Data: Submit manufacturer's technical data for each type of ceiling unit and suspension system required.
- E. Samples: 4-1/4"x 7"x 3/4" – Real Wood Veneer on fire rated particle board– Semi-gloss tinted topcoat – Clear Finish
- F. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.
- G. Non-Conformance: All products not conforming to the requirements of this specification and or the manufacturer's published values are to be disposed. The Contractor performing the work will replace with approved product at their expense.

1.05 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide ceiling panel units and grid components by a single manufacturer.
- B. Fire Performance Characteristics: Identify ceiling components with appropriate markings of applicable testing and inspecting organization.
 - 1. Surface Burning Characteristics: As follows, tested per ASTM E-84 and complying with ASTM E 1264 for Class A products.
 - 2. HPVA (Hardwood Plywood and Veneer Association) certification and audit program per ASTM E-84 tunnel test.
- C. Woodworking Standards: Manufacturer must comply with specified provisions of Architectural Woodworking Institute quality standards.
- D. Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store ceiling components in a dry interior location in their cartons prior to installation to avoid damage. Store cartons in a flat, horizontal position. The protectors between the panels should not be removed until installation.
- B. Do not store in unconditioned spaces with humidity greater than 55 percent or lower than 25 percent relative humidity and temperatures lower than 50 degrees F or greater than 86 degrees F. Panels must not be exposed to extreme temperatures, for example, close to a heating source or near a window with direct sunlight.
- C. Handle ceiling units carefully to avoid chipped edges or damage to units in any way.

1.07 PROJECT CONDITIONS

- A. Wood ceiling materials should be permitted to reach room temperature and have a stabilized moisture content for a minimum of 72 hours before installation. (Remove plastic wrap to allow panels to climatize).
- B. The wood panels should not be installed in spaces where the temperature or humidity conditions vary from the temperatures and conditions that will be normal in the occupied space.

- C. As interior finish products, the veneered panels are designed for installation in temperature conditions between 50 degrees F and 86 degrees F, in spaces where the building is enclosed, and HVAC systems are functioning and will be in continuous operation. Relative humidity should not fall below 25 percent or exceed 55 percent.

1.08 WARRANTY

- A. Veneered Wood Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to:
1. Veneered Wood Panels: Defects in materials or factory workmanship.
 2. Grid System: Rusting and manufacturing defects.
- B. Warranty Period:
1. Veneered Wood panels: One (1) year from date of installation.
 2. Grid: Ten (10) years from date of installation.
- C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.09 MAINTENANCE

- A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
1. Ceiling Units: Furnish quality of full-size units equal to 2.0 percent of amount installed.
 2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 1.0 percent of amount installed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design WoodWorks Grille - Forte' Veneered Ceilings Panels:
1. Armstrong World Industries, Inc.
- B. Suspension Systems:
1. Armstrong World Industries, Inc.
- C. Substitutions: not permitted.

2.02 WOOD CEILING UNITS

- A. Ceiling Panels Type: WD-1
1. Surface Texture: Smooth
 2. Composition: Real wood veneer on fire rated particle board
 3. Finish(s): Real Wood Veneer
 - a. Dark Cherry
 4. Panel Width: as indicated on the drawings.
 - a. Panel Length Size(s): as indicated on the drawings.
 - b. Slat Width: as indicated on the drawings.
 - 1) Height – Number of Slats (Spacing)
 - (a) As indicated on the drawings.
 5. Acoustical Performance Infill:
 - a. Calla Square Lay-in panel - Item 2820BK – NRC 0.85, CAC 35
 6. Flame Spread:
 - a. Class A: ASTM E84 surface burning characteristics. Flame Spread Index 25 or less. Smoke Developed Index 50 or less.

7. Acceptable Product: WoodWorks Grille Forté Veneered Panels –items 6333L_S14-S17, 6334L_S14-S14, 6335L_S14_S17, 6336L_S14-S16 as manufactured by Armstrong World Industries.

- a. Please use ordering format found on manufacturer's data page.

B. Accessories:

1. As required for selected panel configuration(s)

2.03 SUSPENSION SYSTEMS

- A. Components: All main beams and cross tees shall be commercial quality hot dipped galvanized steel as per ASTM A653. Main beams and cross tees are double-web steel construction with 15/16-inch type exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.
 1. Structural Classification: ASTM C635 (Heavy Duty).
 2. Color: Tech Black.
 3. Acceptable Product: Prelude XL 15/16" Exposed Tee Main beam item 7301BL, Prelude XL Exposed Tee item XL7341BL, Prelude XL Exposed Tee 2' item XL7328BL as manufactured by Armstrong World Industries, Inc.
- B. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
- C. Wire for Hangers and Ties: ASTM A641, Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least times-three design load, but not less than 12 gauge.
- D. Accessories/Edge Moldings and Perimeter Trim:
 1. As selected by Architect from manufacturer's standard options.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out.
- B. Proper designs for both supply air and return air, maintenance of the HVAC filters and building interior space are essential to minimize soiling. Before starting the HVAC system, make sure supply air is properly filtered and the building interior is free of construction dust.

3.02 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.
- B. WoodWorks ceiling materials should be permitted to reach room temperature and have a stabilized moisture content for a minimum of 72 hours before installation. (Remove plastic wrap to allow panels to climatize).

3.03 INSTALLATION

- A. Interior WoodWorks products, the veneered wood panels are designed for installation in temperature conditions between 50 degrees F and 86 degrees F, in spaces where the building is enclosed, and HVAC systems are functioning and will be in continuous operation. Relative humidity should not fall below 25 percent or exceed 55 percent.
- B. Install suspension system and panels in compliance with ASTM C636, ASTM E580, with the approval of the authorities having jurisdiction, and in accordance with the manufacturer's WoodWorks Grille Forté Veneered Installation Instructions.

3.04 ADJUSTING AND CLEANING

- A. Replace damaged and broken panels.

- B. Clean exposed surfaces of ceilings panels, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage.

END OF SECTION

SECTION 09 54 34
SUSPENDED MODULAR CEILING MODULES - ARBORISA

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and General Conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Suspended Acoustical Arborisa® Modular Ceiling Modules
 - 2. Cable hangers and fasteners

1.03 RELATED SECTIONS

- A. Division 21 Sections – Fire Suppression
- B. Division 23 Sections - HVAC
- C. Division 26 Sections - Electrical

1.04 REFERENCE STANDARDS

- A. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- B. ASTM E 84/CAN/ULC S102 Standard Test Method for Surface Burning Characteristics of Building Materials.

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Shop Drawings: Provide layout including panel type and components used in the assembly of the ceiling. Show locations of items that are to be coordinated with the ceiling.
- C. Installation Instructions: Submit manufacturer's installation instructions as referenced in Part three, Installation.
- D. Samples: Minimum 6 inch x 6 inch sample of the colors selected in the ceiling design, include manufacturer sample of suspension components.
- E. Product Data: Submit manufacturer's technical data for each type of ceiling unit and suspension system required.
 - 1. LEED V4 qualification documentation.
- F. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.
- G. Non-Conformance: All products not conforming to the requirements of this specification and or the manufacturer's published values are to be disposed. The Contractor performing the work will replace with approved product at their expense.

1.06 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide modules and method of attachment by a single manufacturer.
- B. Fire Performance Characteristics: Identify ceiling components with appropriate markings of applicable testing and inspecting organization.
 - 1. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with Class A products.
 - a. Flame Spread: 25 or less
 - b. Smoke Developed: 450 or less

- C. Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store the Acoustical Arborisa® modular ceiling modules in an interior location and keep in cartons prior to installation to avoid damage.
- B. Exercise care in moving and opening cartons to prevent damage to the module face.
- C. Handle modules carefully to avoid damaging units in any way.

1.08 PROJECT CONDITIONS

- A. Space Enclosure:
 - 1. All wet work must be complete and dry prior to installation. Installation shall be carried out where the temperature is between 40 degrees F and 90 degrees F. These temperature conditions must be maintained throughout the life of the warranty.

1.09 WARRANTY

- A. Acoustical Ceiling Modules: Submit a written warranty executed by the Manufacturer, agreeing to repair or replace modules that fail within the warranty period. Failures include, but are not limited to:
 - 1. Modules: Manufacturing defects.
 - 2. Attachment devices: Rusting and manufacturing defects.
- B. Warranty Period:
 - 1. Modules: One (1) year from date of substantial completion.
 - 2. Attachment devices: One (1) year from date of substantial completion.
- C. Warranty Language:
 - 1. Manufacturer's products are expressly warranted for a period of one (1) year from purchase to be free from defects in material and workmanship, when installed according to manufacturer's published installation procedures. During the warranty period the Manufacturer will repair or at its option replace the products that are proven to be defective. The Manufacturer is NOT responsible for any intentional or accidental abuse, misuse, or neglect incurred on the original warranted product, and shall, as determined by Manufacturer, void the warranty.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Arktura, LLC; www.arktura.com
18225 S. Figueroa St., Gardena, CA 90248.
P. 310-532-1050
info@arktura.com
- B. Substitutions: Not Permitted.

2.02 MODULE UNITS

- A. Acoustical Ceiling Baffle, Type ACB-1:
 - 1. Pattern: NEST
 - 2. Composition: PET plastic (up to 60% recycled) + Metal brackets.
 - 3. Surface Texture: Non-woven, Standard Finish.
 - 4. Material Thickness: 12 mm.
 - 5. Color: Soft Sound Essentials - Sky Blue.
 - 6. Fire Rating: Class A per ASTM E84-14.
 - 7. VOC: Low; no added urea formaldehyde.
 - 8. Module Size: As shown on drawings.

- B. Acoustical Ceiling Baffle, Type ACB-2:
 - 1. Pattern: NEST
 - 2. Composition: PET plastic (up to 60% recycled) + Metal brackets.
 - 3. Surface Texture: Non-woven, Standard Finish.
 - 4. Material Thickness: 12 mm
 - 5. Color: Soft Sound Essentials - Denim
 - 6. Fire Rating: Class A per ASTM E84-14
 - 7. VOC: Low; no added urea formaldehyde.
 - 8. Module Size: As shown on drawings.

2.03 ATTACHMENT SYSTEM

- A. Installation Hardware:
 - 1. 1/32" stainless braided Wire, stainless connector plates, and Griplock tensioning hardware

PART 3 EXECUTION

3.01 PREPARATION

- A. Field verify each ceiling area and establish layout of modules. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation. Module substructure shall be level and plumb. Module substructure shall be structurally sound as determined by that subcontractor's engineer. Module substructure shall be free of defects detrimental to work and erected in accordance with established building tolerances.
- B. Coordinate module layout with mechanical, electrical and sprinkler fixtures as required.
- C. Coordinate delivery of such items to project site.

3.02 INSTALLATION

- A. Install modules in accordance with the manufacturer's instructions and in compliance with the authorities having jurisdiction.
- B. Erect modules level and plumb, in proper alignment in relation to substructure framing and established lines.
- C. Module anchorage shall be structurally sound and per engineering recommendations.
- D. Locate and place ceiling modules level, plumb, and at indicated alignment with adjacent work.
- E. Do not locate the modules in the direct sunlight or sagging from heat and color fade may occur.

3.03 ADJUSTING AND CLEANING

- A. Replace damaged and broken modules.
- B. Routine maintenance of Arborisa® modules should consist of:
 - 1. Vacuum the surface of the material to remove dust accumulation.
 - 2. Blot excess spills from material quickly. Wipe with a damp cloth. If stain persists, apply small quantities of carpet or upholstery shampoo solution with a damp cloth. Blot well with a clean cloth after each application of the solution.
 - 3. Warning, avoid excessive amounts of water. Note: Ensure adequate ventilation if the product is likely to be subject to excessive moisture

3.04 WASTE MANAGEMENT

- A. Arborisa® may be disposed of in standard PET recycling stream provided that no disqualifying foreign matter has been affixed, such as adhesives.
- B. Waste Management:
 - 1. Coordinate recycling of waste materials with Section 01 74 19 - Construction Waste Management and Disposal.

2. Collect recyclable waste and dispose of or recycle field generated construction waste created during demolition, construction or final cleaning.
3. Remove recycling containers and bins from site.

END OF SECTION

**SECTION 09 65 00
RESILIENT FLOORING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Resilient tile flooring.
- B. Resilient base.
- C. Installation accessories.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 03 30 00 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied resilient flooring.
- C. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing & remediation procedures.

1.03 REFERENCE STANDARDS

- A. ASTM D6329 - Standard Guide for Developing Methodology for Evaluating the Ability of Indoor Materials to Support Microbial Growth Using Static Environmental Chambers 1998 (Reapproved 2023).
- B. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).
- C. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source 2019a, with Editorial Revision (2020).
- D. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring 2022.
- E. ASTM F1344 - Standard Specification for Rubber Floor Tile 2021a
- F. ASTM F1861 - Standard Specification for Resilient Wall Base 2021.
- G. ASTM F2169 - Standard Specification for Resilient Stair Treads 2015 (Reapproved 2020).
- H. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes 2019a.
- I. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source 2023.
- J. NSF 332 - Sustainability Assessment for Resilient Floor Coverings 2022.
- K. UL 2824 - GREENGUARD Certification Program Method for Measuring Microbial Resistance from Various Sources Using Static Environmental Chambers Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
 - B. LEED Submittals:
 - 1. Product Data for Credit EQ 4.1: For adhesives, include printed statement of VOC content and chemical components.
 - C. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
 - D. Shop Drawings: Indicate seaming plans; floor patterns.
 - E. Verification Samples: Submit two samples, 6 by 6 inch in size illustrating color and pattern for each resilient flooring product specified.
 - F. Sustainable Design Submittal: Submit VOC content documentation for flooring and adhesives.
-

- G. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- H. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.
- I. Manufacturer's Qualification Statement.
- J. Installer's Qualification Statement.
- K. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- L. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Attic Stock:
 - a. Extra Flooring Material: 10% of each type and color.
 - b. Extra Wall Base: 10% of each type and color.
 - c. Deliver extra materials to Owner's designated storage space, properly packaged with protective covering and identified with labels describing contents.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in installing specified flooring with minimum five years documented experience and approved by flooring manufacturer.
- B. Testing Agency Qualifications: Independent firm specializing in performing concrete slab moisture testing and inspections of the type specified in this section.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 and 70 degrees F.
- D. Do not double stack pallets.

1.07 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F.

PART 2 PRODUCTS

2.01 RESILIENT RUBBER TILE FLOORING

- A. Tarkett Color Splash Speckled Rubber Tile.
 - 1. VE2 Lakeshore.
 - 2. VK4 Perrys Blue.
 - 3. VJ2 Vineyard.
- B. Manufacturers:
 - 1. Tarkett, Inc. 30000 Aurora Rd. Solon, Ohio 44139.
 - a. Phone: (800) 899-8916.
 - b. Web: www.tarkettna.com.
 - c. E-mail: info@johnsonite.com.
- C. Substitutions: Not permitted.
- D. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
- E. Critical Radiant Flux (CRF): Minimum 0.45; 0.22; watt per square centimeter, when tested in accordance with ASTM E648; NFPA 253.
- F. Size: 24x24.

- G. Thickness: 0.125 inch (3.2 mm)
- H. Pattern: As indicated on drawings
- I. Color: As indicated on drawings.

2.02 RESILIENT BASE

- A. Resilient Base: Type TS, rubber, vulcanized thermoset.
 - 1. Style A: Straight.
 - 2. Style B: Cove.
- B. Manufacturers:
 - 1. Johnsonite, a Tarkett Company.
- C. Substitutions: Permitted. See Section 01 25 13 - Product Substitution Procedures.
- D. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648; NFPA 253.
- E. Height: 4 inches (100 mm).
- F. Thickness: 0.125 inch (3.2 mm).
- G. Finish: Matte.
- H. Length: Roll.
- I. Color: Pebble.
- J. Accessories: Premolded, external corners; internal corners; end stops.

2.03 ACCESSORIES

- A. Rubber Wall Base Adhesives: As recommended by Tarkett to meet site conditions.
 - 1. Tarkett 960 Cove Base Adhesive (Porous applications).
 - 2. Tarkett 946 Premium Contact Bond Adhesive (Non-porous applications).
- B. Adhesive for Rubber Flooring: As recommended by Tarkett to meet site conditions.
 - 1. Tarkett 965 Flooring and Tread Adhesive.
 - 2. Tarkett 975 Two-Part Urethane Adhesive.
 - 3. Tarkett 996 Two-Part Epoxy Adhesive.
 - 4. Tarkett 901 SpraySmart Adhesive.
- C. Resilient Leveler Strips: PVC.
 - 1. Tarkett Resilient Leveler Strips: ADA compliant, cut to height as necessary to provide smooth transition between different flooring types/heights.
- D. Sealer and Wax: Types recommended by flooring manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
 - B. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH). Test in accordance with Section 09 05 61.
 - 1. Test as Follows:
 - 2. Alkalinity (pH): ASTM F710.
 - a. Internal Relative Humidity: ASTM F2170.
 - b. Moisture Vapor Emission: ASTM F1869.
 - 3. Conduct tests by an independent testing agency acceptable to Owner.
 - 4. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
-

5. Follow moisture and alkalinity remediation procedures in Section 09 05 61.

C. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Prepare floor substrates for installation of flooring in accordance with Section 09 05 61.
- B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- C. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- D. Prohibit traffic until filler is fully cured.
- E. Clean substrate.
- F. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.03 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Adhesive-Applied Installation:
 - 1. Spread only enough adhesive to permit installation of materials before initial set.
 - 2. Fit joints and butt seams tightly.
 - 3. Set flooring in place, press with heavy roller to attain full adhesion.
- D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- E. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
 - 1. Metal Strips: Attach to substrate before installation of flooring using stainless steel screws.
 - 2. Resilient Strips: Attach to substrate using adhesive.
- F. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- G. Install flooring in recessed floor access covers, maintaining floor pattern.
- H. At movable partitions, install flooring under partitions without interrupting floor pattern.

3.04 INSTALLATION - TILE FLOORING

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.
- B. Square the area and establish reference points on substrates.
- C. Tiles should be lightly butted together when placing into the adhesive.
- D. Concrete floors equipped with radiant heating systems; Turn the heat down to 65 degrees F (18.3 degrees C) for at least 48 hours before installation. Heat may be gradually returned to operating temperature 48 hours after installation. Surface temperature must not exceed 85 degrees F (29.4 degrees C).

3.05 INSTALLATION - RESILIENT BASE

- A. Fit joints tightly and make vertical.
- B. Install base on solid backing. Bond tightly to wall and floor surfaces.
- C. Scribe and fit to door frames and other interruptions.

3.06 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.07 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

3.08 SCHEDULE

- A. Refer to drawings.

END OF SECTION

**SECTION 09 67 23
RESINOUS FLOORING**

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Resinous flooring system as shown on the drawings and in schedules.

1.03 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete

1.04 SYSTEM DESCRIPTION

- A. The work shall consist of preparation of the substrate, the furnishing and application of an epoxy based multi roller applied flooring system. The system shall have the color and texture as specified by the Owner. It shall be applied to the prepared area(s) as defined in the plans strictly in accordance with the Manufacturer's recommendations.
- B. Cove base (if required) to be applied where noted on plans and per manufacturers standard details unless otherwise noted.

1.05 SUBMITTALS

- A. Product Data: Latest edition of Manufacturer's literature including performance data and installation procedures.
- B. Manufacturer's Safety Data Sheet (SDS) for each product being used.
- C. Samples: A 3 x 3 inch square sample of the proposed system. Color, texture, and thickness shall be representative of overall appearance of finished system subject to normal tolerances.

1.06 QUALITY ASSURANCE

- A. The Manufacturer shall have a minimum of 10 years experience in the production, sales, and technical support of epoxy and urethane industrial flooring and related materials.
- B. The Applicator shall have experience in installation of the flooring system as confirmed by the manufacturer in all phases of surface preparation and application of the product specified.
- C. No requests for substitutions shall be considered that would change the generic type of the specified system.
- D. System shall be in compliance with requirements of United States Department of Agriculture (USDA),
- E. Food, Drug Administration (FDA), and local Health Department.
- F. A pre-installation conference shall be held between Applicator, General Contractor and the Owner to review and clarification of this specification, application procedure, quality control, inspection and acceptance criteria and production schedule.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping
 - 1. All components of the system shall be delivered to the site in the Manufacturer's packaging, clearly identified with the product type and batch number.
- B. Storage and Protection
 - 1. The Applicator shall be provided with a storage area for all components. The area shall be between 60 F and 90 F, dry, out of direct sunlight and in accordance with the Manufacturer's recommendations and relevant health and safety regulations.
 - 2. Copies of Safety Data Sheets (SDS) for all components shall be kept on site for review by the Engineer or other personnel.

C. Waste Disposal

1. The Applicator shall be provided with adequate disposal facilities for non-hazardous waste generated during installation of the system.

1.08 PROJECT CONDITIONS

A. Site Requirements

1. Application may proceed while air, material and substrate temperatures are between 60 F and 90 F providing the substrate temperature is above the dew point. Outside of this range, the Manufacturer shall be consulted.
2. The relative humidity in the specific location of the application shall be less than 85 % and the surface temperature shall be at least 5 F above the dew point.
3. The Applicator shall ensure that adequate ventilation is available for the work area.
4. The Applicator shall be supplied with adequate lighting equal to the final lighting level during the preparation and installation of the system.

B. Conditions of new concrete to be coated with epoxy material.

1. Concrete shall be moisture cured for a minimum of 7 days and have fully cured a minimum of twenty eight days in accordance with ACI-308 prior to the application of the coating system pending moisture tests.
2. Concrete shall have a flat rubbed finish, float or light steel trowel finish (a hard steel trowel finish is neither necessary nor desirable).
3. Sealers and curing agents should not to be used.
4. Concrete surfaces on grade shall have been constructed with a vapor barrier to protect against the effects of vapor transmission and possible delamination of the system.

C. Safety Requirements

1. All open flames and spark-producing equipment shall be removed from the work area prior to commencement of application.
2. "No Smoking" signs shall be posted at the entrances to the work area.
3. The Owner shall be responsible for the removal of foodstuffs from the work area.
4. Non-related personnel in the work area shall be kept to a minimum.

1.09 WARRANTY

- A. Dur-A-Flex, Inc. warrants that material shipped to buyers at the time of shipment substantially free from material defects and will perform substantially to Dur-A-Flex, Inc. published literature if used in accordance with the latest prescribed procedures and prior to the expiration date.
- B. Dur-A-Flex, Inc. liability with respect to this warranty is strictly limited to the value of the material purchase.

PART 2 – PRODUCTS

2.01 MANUFACTURER

- A. Basis of Design: Dur-A-Flex, Inc.,
95 Goodwin Street, East Hartford, CT 06108
Phone: (860) 528-9838, Fax: (860) 528-2802
www.dur-a-flex.com
- B. Manufacturer of Approved System shall be single source and made in the USA.

2.02 FLOORING – PAVILION RESTROOMS

- A. Dur-A-Flex, Inc; Dur-A-Chip Broadcast with Urethane Topcoat (to be referenced as **Micro**)
1. System Materials:
 - a. Primer: Dur-A-Glaze #4 WB resin and hardener.
 - b. First Broadcast Coat: Dur-A-Gard OPF resin and hardener.
 - 1) Chips: Micro Decorative Colored Chips.
 - c. Second Broadcast and Grout Coat: Dur-A-Glaze #4 resin and Water Clear hardener.

- 1) Chips: Micro Decorative Colored Chips.
 - d. Grout coat: Dur-A-Glaze #4 resin and Water Clear hardener.
 - e. Topcoat: Armor Top resin, hardener and grit.
 - f. Nominal Thickness: 60mils
2. Patch Materials
 - a. Shallow Fill and Patching: Use Dur-A-Glaze #4 Cove Rez.
 - b. Deep Fill and Sloping Material (over ¼ inch): Use Dur-A-Crete.

2.03 FLOORING - CUSTODIAL 105A, 155 AND STORAGE 118

- A. Dur-A-Flex, Inc, Shop Floor Epoxy Broadcast seamless flooring system (to be referenced as **Shop Floor**)
 1. System Materials:
 - a. Primer: Dur-A-Glaze #4 WB resin and hardener.
 - b. First Broadcast Coat: Dur-A-Gard OPF resin and hardener.
 - 1) Chips: Micro Decorative Colored Chips.
 - c. Second Broadcast and Grout Coat: Dur-A-Glaze #4 resin and Water Clear hardener.
 - 1) Chips: Micro Decorative Colored Chips.
 - d. Dur-A-Glaze #4 resin and Water Clear hardener.
 - e. Topcoat: Armor Top resin, hardener and grit.
 - f. Nominal Thickness: 1/8 inch
 2. Patch Materials
 - a. Shallow Fill and Patching: Use Dur-A-Glaze #4 Cove Rez.
 - b. Deep Fill and Sloping Material (over ¼ inch): Use Dur-A-Crete.

2.04 PRODUCT REQUIREMENTS – DUR-A-CHIP (MICRO)

- A. Primer: Dur-A-Glaze #4 WB
 1. Percent Solids: 56 %
 2. VOC: 2 g/L
 3. Bond Strength to Concrete ASTM D 4541: 550 psi, substrates fails
 4. Hardness, ASTM D 3363: 3H
 5. Elongation, ASTM D 2370: 9 %
 6. Flexibility (1/4: Cylindrical mandrel), ASTM D 1737: Pass
 7. Impact Resistance, MIL D-2794: >160
 8. Abrasion Resistance ASTM D 4060
 - a. CS 17 wheel; 1,000g Load: 30 mg loss
- B. Broadcast Coat: Dur-A-Gard OPF
 1. Percent Solids: 100 %
 2. VOC: 59 g/L
 3. Compressive Strength, ASTM D 695: 16,000 psi
 4. Tensile Strength, ASTM D 638: 3,800 psi
 5. Flexural Strength, ASTM D 790: 4,000 psi
 6. Abrasion Resistance, ASTM D 4060
 - a. C-10 Wheel, 1,000 gm load; 1,000 cycles: 35 mg loss
 7. Flame Spread/NFPA-101, ASTM E 84: Class A
 8. Impact Resistance MIL D-3134: 0.025 inch Max
 9. Water Absorption MIL D-3134: Pass
 10. Potlife @ 70 F: 20-25 minutes
- C. Broadcast Coat and Grout Coat: Dur-A-Glaze #4 Water Clear
 1. Percent Solids: 100 %
 2. VOC: 3.8 g/L
 3. Compressive Strength, ASTM D 695: 11,200 psi

4. Tensile Strength, ASTM D 638: 2,100 psi
 5. Flexural Strength, ASTM D 790: 5,100 psi
 6. Abrasion Resistance, ASTM D 4060
 - a. C-10 Wheel, 1,000 gm load; 1,000 cycles: 29 mg loss
 7. Flame Spread/NFPA-101, ASTM E 84: Class A
 8. Impact Resistance MIL D-24613: 0.0007 inches, no cracking or delamination
 9. Water Absorption. MIL D-24613: Nil
 10. Potlife @ 70 F: 20 minutes
- D. Topcoat: Armor Top
1. Percent Solids: 95 %
 2. VOC: 0 g/L
 3. Tensile Strength, ASTM D 2370: 7,000 psi
 4. Adhesion, ASTM 4541: Substrate Failure
 5. Hardness, ASTM D 3363: 4H
 6. 60° Gloss ASTM D 523: 70
 7. Abrasion Resistance, ASTM D4060 Gloss; Satin
 - a. CS 17 wheel (1,000 g load) 1,000 cycles:
 - 1) Gloss: 4 mg loss with grit; 10 mg loss without grit
 - 2) Satin: 8 mg loss with grit; 12 mg loss without grit
 8. Pot Life, 70 F, 50% RH: 2 Hours
 9. Full Chemical Resistance: 7 days

2.05 PRODUCT REQUIREMENTS – EPOXY BROADCAST (SHOP FLOOR)

- A. Primer: Dur-A-Glaze #4 WB
1. Percent Solids: 56 %
 2. VOC: 2 g/L
 3. Bond Strength to Concrete ASTM D 4541: 550 psi, substrates fails
 4. Hardness, ASTM D 3363: 3H
 5. Elongation, ASTM D 2370: 9 %
 6. Flexibility (1/4: Cylindrical mandrel), ASTM D 1737: Pass
 7. Impact Resistance, MIL D-2794: >160
 8. Abrasion Resistance ASTM D 4060,
 - a. CS 17 wheel; 1,000 g Load: 30 mg loss
- B. Broadcast and Grout Coat: Dur-A-Guard OPF
1. Percent Solids: 95.2%
 2. VOC: 8 g/L
 3. Compressive Strength, ASTM D 695: 17,500 psi
 4. Tensile Strength, ASTM D 638: 4,000 psi
 5. Flexural Strength, ASTM D 790: 6,250 psi
 6. Flexural Modulus of Elasticity, ASTM D 790: 6.2×10^5
 7. Abrasion Resistance, ASTM D 4060
 - a. CS 17 Wheel, 1,000 gm load; 1,000 cycles: 24 mg loss
 8. Flame Spread/NFPA-101, ASTM E 84: Class B
 9. Flammability, ASTM D 635: Self Extinguishing
 10. Indentation, MIL D-3134: 0.025 Max
 11. Impact Resistance MIL D-3134: Pass
 12. Water Absorption. ASTM D-750: 0.04%
- C. Topcoat: Armor Top
1. Percent Solids: 95.2 %
 2. VOC: 0 g/L
 3. Tensile Strength, ASTM D 2370: 7,000 psi

4. Adhesion, ASTM 4541: Substrate Failure
5. Hardness, ASTM D 3363: >4H
6. 60° Gloss ASTM D 523; Gloss: 75 +/- 10; Satin: 50+/- 10.
7. Abrasion Resistance, ASTM D4060
 - a. CS 17 wheel (1,000 g load) 1,000 cycles
 - 1) Gloss: 4 mg loss with grit; 10 mg loss without grit
 - 2) Satin: 8 mg loss with grit; 12 mg loss without grit
8. Pot Life, 70 F, 50% RH: 45 mins
9. Full Chemical Resistance: 7 days

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas and conditions, with Applicator present, for compliance with requirements for maximum moisture content, installation tolerances and other conditions affecting flooring performance.
- B. Verify that substrates and conditions are satisfactory for flooring installation and comply with requirements specified.

3.02 PREPARATION

- A. General
 1. New and existing concrete surfaces shall be free of oil, grease, curing compounds, loose particles, moss, algae growth, laitance, friable matter, dirt, and bituminous products.
 2. Moisture Testing: Perform tests recommended by manufacturer and as follows.
 - a. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.
 - b. If the relative humidity exceeds 75% then Dur-A-Glaze MVP Primer moisture mitigation system by Dur-A-Flex, Inc must be installed prior to resinous flooring installation. Slab-on grade substrates without a vapor barrier may also require this moisture mitigation system.
 3. There shall be no visible moisture present on the surface at the time of application of the system. Compressed oil-free air and/or a light passing of a propane torch may be used to dry the substrate.
 4. Mechanical surface preparation
 - a. Shot blast all surfaces to receive flooring system with a mobile steel shot, dust recycling machine (Blastrac or equal). All surface and embedded accumulations of paint, toppings hardened concrete layers, laitance, power trowel finishes and other similar surface characteristics shall be completely removed leaving a bare concrete surface having a minimum profile of CSP 3-4 as described by the International Concrete Repair Institute.
 - b. Floor areas inaccessible to the mobile blast machines shall be mechanically abraded to the same degree of cleanliness, soundness and profile using diamond grinders, needle guns, bush hammers, or other suitable equipment.
 - c. Where the perimeter of the substrate to be coated is not adjacent to a wall or curb, a minimum 1/4 inch key cut shall be made to properly seat the system, providing a smooth transition between areas. The detail cut shall also apply to drain perimeters and expansion joint edges.
 - d. Cracks and joints (non-moving) greater than 1/8 inch wide are to be chiseled or chipped-out and repaired according to the manufacturer's recommendations.
 5. At spalled or worn areas, mechanically remove loose or delaminated concrete to a sound concrete and patch per manufactures recommendations.

3.03 APPLICATION

- A. General
 1. The system shall be applied in six distinct steps as listed below:
 - a. Substrate preparation

-
- b. Priming
 - c. First broadcast coat application with first chip broadcast
 - d. Second broadcast coat with second chip broadcast
 - e. Grout coat application
 - f. Topcoat application
2. Immediately prior to the application of any component of the system, the surface shall be dry and any remaining dust or loose particles shall be removed using a vacuum or clean, dry, oil-free compressed air.
 3. The handling, mixing and addition of components shall be performed in a safe manner to achieve the desired results in accordance with the manufacturer's recommendations.
 4. The system shall follow the contour of the substrate unless pitching or other leveling work has been specified by the Architect.
 5. A neat finish with well-defined boundaries and straight edges shall be provided by the Applicator.
- B. Primer
1. **Micro:** the primer shall be Dur-A-Glaze #4 WB Primer that is mixed at the ratio of 1 part resin to 4 parts hardener per the manufacturer's instructions.
 - a. The primer shall be applied by 1/8 inch notched squeegee and back rolled at the rate of 200 sf/gal to yield a dry film thickness of 4 mils.
 2. **Shop Floor:** the primer shall consist of a liquid resin and hardener that is mixed at the ratio of 1 part resin to 4 parts hardener per the manufacturer's instructions.
 - a. The primer shall be applied by 1/8 inch notched squeegee and back rolled at the rate of 200 sf/gal to yield a dry film thickness of 6 mils.
- C. Broadcast Coats
1. The broadcast coat shall be applied as a double broadcast system as specified by the Architect.
 2. The broadcast coat shall be comprised of two components: a resin, and hardener as supplied by the Manufacturer and mixed in the ratio of 2 parts resin to 1 part hardener.
 3. The resin shall be added to the hardener and thoroughly mixed by suitably approved mechanical means.
 4. First Broadcast Coat
 - a. **Micro:** The first broadcast coat shall be applied over horizontal surfaces using the dip and roll, and back roll method at the rate of 300 sf/gal using the Dur-A-Gard OPF material.
 - 1) Chips shall be broadcast to excess into the wet material at the rate of 0.15 lbs/sf.
 - 2) Allow material to fully cure. Vacuum, sweep and/or blow to remove all loose aggregate.
 - 3) Scrape the floor with a trowel or floor scraper. Sweep and vacuum the floor again.
 - b. **Shop Floor:** The first broadcast coat shall be applied over horizontal surfaces using "v" notched squeegee and back rolled at the rate of 90-100 sf/gal.
 - 1) Quartz aggregate shall be broadcast to excess into the wet material at the rate of 0.5 lbs/sf.
 - 2) Allow material to fully cure. Vacuum, sweep and/or blow to remove all loose aggregate.
 5. Second Broadcast Coat
 - a. **Micro:** Apply a second broadcast coat of resin shall be applied by flat squeegee then back rolled with a coverage rate of 150 sf/gal with the Dur-A-Glaze #4 Water Clear epoxy.
 - 1) Chips shall be broadcast to excess at the rate of 0.15 lbs/sf.
 - 2) Allow material to fully cure. Vacuum, sweep and/or blow to remove all loose chips.
 - 3) Scrape the floor with a trowel or floor scraper. Sweep and vacuum the floor again.
 - b. **Shop Floor:** Apply a second coat of resin with a coverage rate of 90-100 sf/gal
 - 1) Broadcast flintshot aggregate to rejection at the rate of 0.5 lbs/sf.
 - 2) Allow material to fully cure. Vacuum, sweep and/or blow to remove all loose chips.
- D. Grout Coat
-

1. **Micro:** The grout coat shall be comprised of a Dur-A-Glaze # 4 Water Clear epoxy that is mixed in the ratio of 1 part hardener to 2 parts resin and installed per the manufacturer's recommendations.
 - a. The grout coat shall be squeegee applied and back rolled with a coverage rate of 100 sf/gal.
 2. **Shop Floor:** The grout coat shall be comprised of liquid components, combined at a ratio of 2 parts resin to 1 part hardener by volume and shall be thoroughly blended by mechanical means such as a high speed paddle mixer.
 - a. The grout coat shall be squeegee applied with a coverage rate of 90-100 sf/gal
 - b. The grout coat will be back rolled and cross rolled to provide a uniform texture and finish
- E. Topcoat (Urethane)
1. **Micro:** The topcoat of Armor Top shall be roller applied at the rate of 500 sf/gal to yield a dry film thickness of 3 mils.
 - a. The finish floor will have a nominal thickness of 60 mils.
 2. **Shop Floor:** The topcoat of Armor Top shall be roller applied at the rate of 500 sf/gal to yield a dry film thickness of 3 mils.
 - a. The topcoat shall be comprised of a liquid resin, hardener and pigment mixed per the manufacturer's instructions.
 - b. The finished floor will have a nominal thickness of 1/8 inch.

3.04 FIELD QUALITY CONTROL

- A. Tests, Inspection
1. The following tests shall be conducted by the Applicator:
 - a. Temperature
 - 1) Air, substrate temperatures and, if applicable, dew point.
 - b. Coverage Rates
 - 1) Rates for all layers shall be monitored by checking quantity of material used against the area covered.

3.05 CLEANING AND PROTECTION

- A. Cure flooring material in compliance with manufacturer's directions, taking care to prevent their contamination during stages of application and prior to completion of the curing process.
- B. Remove masking. Perform detail cleaning at floor termination, to leave cleanable surface for subsequent work of other sections.

END OF SECTION

SECTION 09 68 13
CARPET TILE**PART 1 – GENERAL****1.01 SUMMARY**

- A. Carpet tile
- B. Adhesives and accessories
- C. Floor Preparation

1.02 RELATED SPECIFICATIONS

- A. Section 01 74 19 - Construction Waste Management and Disposal.
- B. Section 03 30 00 - Cast-in-Place Concrete.
- C. Section 09 05 61 - Common Work Results for Flooring Preparation.

1.03 REFERENCE STANDARDS

- A. CRI 104 – Standard for Installation of Commercial Carpet; Carpet and Rug Institute; 2015

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Submit manufacturer's product data for each type of carpet tile material and installation accessories required. Submit manufacturer's printed data on physical characteristics, durability, fade resistance, and fire-tested response characteristics. Submit methods of installation for each type of substrate.
- C. Samples: Submit two full size samples of each type of carpet tile specified for verification purposes, showing full range of color, texture, and pattern variations expected. Prepare samples from same material to be used for the project. Label each sample with manufacturer's name, material description, color, pattern, and designation indicated on drawings and/or room finish schedule.
- D. Manufacturer's Installation Instructions: Indicate special procedures.
- E. Maintenance Data: Submit maintenance data for each type of carpet tile to be included in operation and maintenance manual. Include recommended maintenance materials and suggested schedule for cleaning.
- F. Attic Stock:
 - 1. Furnish quantity equal to 10% for each type and color of carpet tile installed.
 - 2. Deliver extra carpet tile materials to Owner's designated storage space, properly package with protective covering and identified with labels describing contents.

1.05 PRE-INSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to carpet tile installation including, but not limited to the following:
 - a. Review delivery, storage, and handling procedures.
 - b. Review ambient conditions and ventilation procedures.
 - c. Review subfloor preparation procedures
 - d. Review carpet installation layout

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer with a minimum of five (5) years of successful experience in carpet tile installation of similar in size and type to the carpeting requirements of this project.

1.07 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period. Failures include, but not limited to more than 10 percent loss of face fiber, tile curling, snags, runs and delamination that are not due to usual traffic, failure of substrate, vandalism or abuse.
- B. Warranty Period: Ten (10) years from date of Substantial Completion.
- C. Installer's Warranty: Submit a certificate guaranteeing the installation to be free of defects in workmanship for a period of one year. Installer will correct and/or replace any improper work and material upon written notice from the Owner or their representative.

PART 2 – PRODUCTS**2.01 MATERIALS**

- A. Carpet Tiles:
 - 1. Milliken Revelation Pathway Trimline.
 - a. Color: PWY277 Forest, PWY52 Sail.
 - b. Installation: Ashlar Plank.
 - c. Substitutions not permitted.
- B. Walk-off Tiles:
 - 1. Interface Flor Industrious
 - a. Color: Beige, Mahogany, Lime.
 - b. Installation: Quarter Turn.
 - c. Substitutions not permitted.

2.02 INSTALLATION ACCESSORIES

- A. Trowel-able Leveling and Patching Compounds: Latex modified, hydraulic cement based formulation provided or recommended by carpet tile manufacturer for applications indicated.
- B. Adhesive: Water-resistant, mildew resistant, non-staining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirement for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
- C. Carpet Tile Reducer Strip: Extruded or molded heavy-duty vinyl or rubber carpet tile reducer strip of size and profile recommended by carpet tile manufacturer with a minimum 2 inch wide anchorage flange. Colors as selected by Owner from manufacturer's full range.

PART 3 - EXECUTION**3.01 EXAMINATION**

- A. Examine substrates, areas, and condition, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
- B. Examine Carpet Tile for type, color, pattern and potential defects.
- C. Verify that sub-floor surfaces are dust free and free of substances (curing compounds, sealers, hardeners, etc.) that could impair bonding of adhesive materials to sub-floor surfaces.

3.02 PREPARATION

- A. General: Comply with CRI 104, Section 6.2 Site Conditions: Floor Preparation and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
 - B. Prepare floor substrates as recommended by flooring manufacturer.
 - C. Use trowel-able leveling and patching compounds, according to manufacturer's written instructions to fill cracks, holes, depressions, and protrusions in substrates. Fill or level crack, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch, unless more stringent requirements are required by manufacturer's written instructions.
-

- D. Install trowel-able leveling and patching compounds at locations where carpet tile meets ceramic tile flooring so that one-half of carpet tile pile height will be above tile. Feather compound to a distance of not less than two feet from edge of tile.
- E. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil or silicone without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- F. Broom and vacuum clean substrates to be covered immediately before installing carpet tile. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 INSTALLATION

- A. Install carpet tile in accordance with manufacturer's instructions and CRI 104 Section 14 "Carpet Modules".
- B. Blend carpet from different cartons to ensure minimal variation in color match.
- C. Apply floor adhesive uniformly to substrate in accordance with manufacturer's instruction. Butt carpet tile edges firmly together to form seams without gaps. Remove adhesive promptly from face of carpet.
- D. Install edge moldings where carpet edge is exposed and at transitions to other floor coverings. Edge moldings shall be securely anchored to substrate.
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, threshold, and nosings. Bind or seal cut edges as recommend by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Carpet to be secured to the floor in compliance with Americans with Disabilities Act: (ADA), Section 4.5.3.
- H. When installing Milliken modular carpet over a radiant heated floor system, the heat system must be turned off 48 hrs. prior to, during and at least 48 hrs. afterwards to allow proper adhesive setup.
While the radiant heat system may indicate temps of 85 – 120 degrees, rarely does the subfloor achieve these temperatures. Subfloor temp should not exceed 85 degrees.

3.04 CLEANING AND PROTECTION

- A. Immediately after installing carpet tile:
 - 1. Remove excess adhesive, seam sealer and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet using commercial machine with face-beater element
- B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations".

END OF SECTION

**SECTION 09 83 00
ACOUSTIC FINISHES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Field application of acoustic finishes.
- B. Surface preparation.

1.02 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies.
- B. Section 09 84 11 - Wall-Mounted Acoustic Panels.

1.03 REFERENCE STANDARDS

- A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023.
- B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.
- D. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests; 2023.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Manufacturer's data sheets for products specified.
- C. Samples: Submit two samples ____ by ____ inch (____ by ____ mm) in size indicating colors for selection.
- D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- E. Applicator's qualification statement.
- F. Maintenance Data: Provide manufacturer's data on maintenance and renewal of applied finishes.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Coating Materials: 1 gallon (4 L) of each color; store where directed.
 - a. Label each container with color in addition to the manufacturer's label.
 - 3. Extra Wall Covering Materials: 25 linear feet (8 linear m) of each color and pattern of wall covering; store where directed.
 - a. Package and label each roll by manufacturer, color and pattern, and destination room number.

1.05 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in installing work of the type specified in this section, and with at least three years of documented experience.

1.06 MOCK-UPS

- A. See Section 01 43 39 - Mockups for requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Store and handle materials according to manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not apply acoustical finishes when surface and ambient temperatures are outside the temperature ranges required by manufacturer.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Acoustic Wall Coverings:
 - 1. CSI Wall Panels; <https://www.csicreative.com/>
 - 2. Armstrong; <https://www.armstrongceilings.com/commercial/en/>
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ACOUSTIC FINISHES

- A. General:
 - 1. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Acoustic Wall Coverings:
 - 1. Description: CSI Wall Panels
 - a. Product: Five Senses
 - 1) Noise Reduction Coefficient (NRC) of not less than 0.25 when applied to 1/2 inch (13 mm) gypsum board.
 - 2) Surface Burning Characteristics: Flame Spread Index of 10, maximum; Smoke Developed Index of 95, maximum; when tested in accordance with ASTM E84.
 - 3) Color: As indicated on the drawings.
 - 4) Adhesive: Type recommended by wall covering manufacturer to suit application.
 - 2. Description: Armstrong
 - a. Product: Forte Woodworks
 - 1) Sound Absorption: Noise Reduction Coefficient (NRC) of 0.70 for 1-inch thick material when tested in accordance with ASTM C423 for Type A mounting, per ASTM E795.
 - 2) Surface Burning Characteristics: Flame Spread Index of 25, maximum; Smoke Developed Index of 50, maximum; when tested in accordance with ASTM E84.
 - 3) Color: As indicated on the drawings.
 - 4) Adhesive: Type recommended by wall covering manufacturer to suit application.
- C. Accessory Materials: Provide primers, sealers, cleaning agents, and clean up materials as required for completion of acoustic finish.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Do not begin application of acoustic finishes until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

3.02 PREPARATION

- A. Acoustic Wall Coverings:
 - 1. Seal surfaces that may cause bleed through or staining of wall covering.

3.03 APPLICATION

- A. Acoustic Wall Coverings: Apply in accordance with manufacturer's written instructions.
 - 1. Apply premixed adhesive directly to wall.
 - 2. Cut material to desired length and along vertical edge of ribbed pattern. Install in vertical strips, edges butted.
 - 3. Apply wall covering smooth, without wrinkles, gaps, or overlaps. Eliminate air pockets and ensure full bond to substrate surface.
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3.04 FIELD QUALITY CONTROL

- A. See Section 01 45 16-Field Quality Control Procedures for City of Madison requirements.

3.05 CLEANING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.
- B. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.
- C. Remove masking and covering and residue left from masking.

3.06 PROTECTION

- A. Protect finishes from subsequent construction operations.
- B. Touch-up damaged finishes.

END OF SECTION

SECTION 09 84 11
WALL-MOUNTED ACOUSTIC PANELS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

- A. Wall-mounted acoustic panels.

1.02 RELATED WORK

- A. Section 061000 - Rough Carpentry; concealed blocking and supports.

1.03 SUBMITTALS

- A. Product Data: Submit for each product indicating materials, dimensions, profiles, textures and colors. Include installation instructions.
- B. Shop Drawings: Submit shop drawings indicating plans, elevations, details of construction, and relationship with adjacent construction.
- C. Verification Samples: Submit representative sample of felt in color and pattern specified.
- D. LEED documentation.
- E. Attic Stock:
1. Furnish quantity equal to 5% for each type and color.
 2. Deliver extra materials to Owner's designated storage space, properly packaged with protective covering and identified with labels describing contents.

1.04 QUALITY ASSURANCE

- A. Manufacturer: Minimum of 2 years manufacturing similar products.
- B. Installer: Minimum of 2 years installing similar products.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Storage and Handling: Comply with manufacturer's recommendations for storage and handling. Protect from weather damage.

1.06 WARRANTY

- A. Warranty: Provide manufacturer's standard limited warranty against defects in manufacturing.

PART 2 PRODUCTS

2.01 WALL-MOUNTED ACOUSTIC PANELS

- A. Type AWP-01 - Plank System: 100% Wool Design Felt and Akustika 10.
1. Basis of Design: ARO Plank 2 by Filzfelt.
 2. Materials:Felt: 100% Wool Design Felt, 100 percent biodegradable.
 - a. Akustika 10: 100 percent recyclable.
 - b. Contains no formaldehyde, chemical irritants, or harmful substances.
 - c. VOC free.
 3. Module A Width: 5 in (127 mm).
 4. Module B Width: 3 in (76 mm).
 5. Configuration: 2.5; Repeat AAABB
 6. Orientation: Vertical.
 7. Colors: As selected from manufacturer's standard colors.
 8. Mounting Method: Interlock Mounting System.
 9. Properties:
 - a. NRC (ASTM C423): 0.65.
 - b. SAA (ASTM C423): 0.61.

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- c. Colorfastness to Light Class: 4–5 (40 hours).
 - d. Colorfastness to Crocking: Class 3–4 (wet), Class 4–5 (dry).
 - e. Oeko-Tex Standard 100 Certified Product Class II (100% Wool Design Felt).
 - 10. Substitutions not permitted.
- B. Type AWP-02 - 100% Wool Design Felt and Acoustic Substrate.
- 1. Basis-of-Design: Gap by FilzFelt.
 - 2. Materials:
 - a. Felt: 100% Wool Design Felt, 100 percent biodegradable.
 - b. Substrate: Akustika 10 Substrate, 100 percent recyclable.
 - c. Contains no formaldehyde, chemical irritants, or harmful substances.
 - d. VOC free.
 - 3. Tile Thickness: 1/2 inch (13 mm).
 - 4. Tile Sizes: Modules A,B,C & D: 5'-0" x 1'-0" (152.4 x 30.5 cm); Modules E,F,G & H: 3'-4" x 1'-0" (101.6 x 30.5 cm); Modules I,J,K & L: 1'-8" x 1'-0" (50.8 x 30.5 cm)
 - 5. Felt Color: As selected from manufacturer's standard colors.
 - 6. Substrate Color: 03 Dark Grey.
 - 7. Edge: Exposed.
 - 8. Mounting Method: Construction adhesive.
 - 9. Properties:
 - a. NRC (ASTM C423): 0.50.
 - b. SAA (ASTM C423): 0.51.
 - c. Colorfastness to Light Class: 4–5 (40 hours).
 - d. Colorfastness to Crocking: Class 3–4 (wet), Class 4–5 (dry).
 - 10. Substitutions not permitted.
- C. Type AWP-03 - 100% Wool Design Felt and Acoustic Substrate.
- 1. Basis-of-Design: Ion by FilzFelt.
 - 2. Materials:
 - a. Felt: 100% Wool Design Felt, 100 percent biodegradable.
 - b. Substrate: 100 percent recyclable.
 - c. Contains no formaldehyde, chemical irritants, or harmful substances.
 - d. VOC free.
 - 3. Panel Thickness: 1 1/4 in (32 mm).
 - 4. Panel Size: 2'-10" x 9'-8"
 - 5. Color Configuration: 2-Color
 - a. Color 1: As selected from manufacturer's standard colors
 - b. Color 2: As selected from manufacturer's standard colors
 - 6. Trim: End-of-Run Trim and Baseboard Trim
 - 7. Mounting Method: Z-Clips preinstalled.
 - 8. Properties:
 - a. NRC (ASTM C423): 0.60.
 - b. SAA (ASTM C423): 0.57.
 - c. Colorfastness to Light Class: 4–5 (40 hours).
 - d. Colorfastness to Crocking: Class 3–4 (wet), Class 4–5 (dry).
 - e. Environmental: Living Building Challenge Criteria Compliant, Oeko-Tex® Standard 100 Certified Product Class II (100% Wool Design Felt + Akustika 10 Substrate), Meets VOC test limits for the CDPH v1.2 method.
 - 9. Substitutions not permitted.
- D. Type AWP-04 - Fabric Covered Wall Panels.
- 1. Basis of Design: Decoustics Wall Panels (Pavillion).
 - 2. Size: up to 48x120 fabric; refer to drawings.
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3. Thickness: 1 inch.
 4. Weight: 0.88 PSF.
 5. NRC: 0.85.
 6. Fabric 1: Maharam Eave, Sandglass 466608-001.
 7. Substitutions not permitted.
- E. Type AWP-05 - Fabric Covered Wall Panels.
1. Basis of Design: Decoustics Wall Panels (Pavillion)
 2. Size: up to 48x120 fabric; refer to drawings.
 3. Thickness: 1 inch.
 4. Weight: 0.88 PSF.
 5. NRC: 0.85.
 6. Fabric 2: Maharam Eave, Sparks 466608-014.
 7. Substitutions not permitted.
- F. Environmental: Living Building Challenge Criteria Compliant, Oeko-Tex Standard 100 Certified Product Class II (100% Wool Design Felt + Acoustic Substrate), Meets VOC test limits for the CDPH v1.2 method (100% Wool Design Felt + Akustika 10 Substrate).

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine existing conditions to determine that they are suitable for installation. Proceed with installation only when unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Install units in accordance with manufacturer's instructions, approved submittals, and in proper relationship to adjacent construction.

3.03 ADJUSTING AND CLEANING

- A. Adjust units for proper position, uniform appearance and operation.
- B. Clean exposed and semi-exposed surfaces using materials acceptable to manufacturer.

END OF SECTION

**SECTION 09 91 13
EXTERIOR PAINTING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
- D. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 5. Floors, unless specifically indicated.
 - 6. Glass.
 - 7. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 09 90 00 - Paintings and Coatings
- C. Section 09 91 23 - Interior Painting.
- D. Section 09 96 00 - High-Performance Coatings.
- E. Section 21 05 53 - Identification for Fire Suppression Piping and Equipment: Painted identification.
- F. Section 22 05 53 - Identification for Plumbing Piping and Equipment: Painted identification.
- G. Section 23 05 53 - Identification for HVAC Piping and Equipment: Painted identification.
- H. Section 26 05 53 - Identification for Electrical Systems: Painted identification.
- I. Section 32 17 23 - Pavement Markings: Painted pavement markings.

1.03 DEFINITIONS

- A. Comply with ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

- A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2023.
- B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.
- C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
 - B. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.
 - C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
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2. Extra Paint and Finish Materials: 1 gallon (4 L) of each color; from the same product run, store where directed.
3. Label each container with color in addition to the manufacturer's label.

1.06 QUALITY ASSURANCE

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

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the paint product manufacturer's temperature ranges.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
- B. Paints:
 1. Base Manufacturer: Benjamin Moore; <https://www.benjaminmoore.com/en-us>.
 2. Behr Process Corporation: www.behr.com/#sle.
 3. Cloverdale Paint, Brand Products of Rodda Paint Company: www.cloverdalepaint.com/#sle.
 4. Diamond Vogel Paints: www.diamondvogel.com/#sle.
 5. Dow: www.dow.com/#sle.
 6. Dunn-Edwards Corporation: www.dunnedwards.com/#sle.
 7. Kelly-Moore Paints: www.kellymoore.com/#sle.
 8. PPG Paints: www.ppgpaints.com/#sle.
 9. Rodda Paint Company: www.rodgapaint.com/#sle.
 10. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
 11. Vista Paint Corporation: www.vistapaint.com/#sle.
- C. Primer Sealers: Same manufacturer as top coats.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.
 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 2. Supply each paint material in quantity required to complete entire project's work from a single production run.
 3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.

2.03 PAINT SYSTEMS - EXTERIOR

- A. Paint E-OP - Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including concrete, concrete masonry units, brick, fiber cement siding, primed wood, and primed metal.
 - 1. Two top coats and one coat primer.
- B. Paint E-TR-C - Transparent Finish on Concrete Floors:
 - 1. 1 coat stain.
 - 2. Stain: Semi-Transparent Stain for Concrete Floors; MPI #58.
 - 3. Sealer: Water Based Sealer for Concrete Floors; MPI #99.
 - 4. Sealer Sheen:
 - a. Gloss: MPI gloss level 6; use this sheen at all locations.

2.04 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
 - 1. Alkali-Resistant Water-Based Primer.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Do not begin application of paints and finishes until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- E. Test shop-applied primer for compatibility with subsequent cover materials.
- F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Fiber Cement Siding: 12 percent.
 - 2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
 - 3. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.
 - 4. Concrete Floors and Traffic Surfaces: 8 percent.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Concrete:

- G. Masonry:
- H. Fiber Cement Siding: Remove dirt, dust and other foreign matter with a stiff fiber brush. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
- I. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
- J. Exterior Wood Surfaces to Receive Opaque Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior calking compound after prime coat has been applied. Back prime concealed surfaces before installation.

3.03 APPLICATION

- A. Exterior Wood to Receive Opaque Finish: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 4 weeks.
- B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance.
- E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 45 16-Field Quality Control Procedures for City of Madison requirements for general requirements for field inspection.

3.05 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

**SECTION 09 91 23
INTERIOR PAINTING****PART 1 – GENERAL****1.01 SCOPE**

- A. This section includes information common to painting and coating and applies to the entire project
- B. Priming or priming and finishing of certain surfaces are specified to be factory performed or installer performed under pertinent other Sections. Do not include painting which is specified under other Sections.
- C. Where drawings and schedules calls for painted finishes, provide painted systems as specified herein. Work included: All interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
- D. Unless otherwise indicated, painting is not required on surfaces in concealed areas and inaccessible areas such as furred spaces, foundation spaces, utility tunnels, pipe spaces, and duct shafts.
- E. Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze, and similar finished materials will not require painting under this Section except as may be specified herein.
- F. Do not paint any moving parts of operating units; mechanical or electrical parts such as valve operators, linkages, sinkages, sensing devices, and motor shafts, unless otherwise indicated.
- G. Do not paint over any required labels or equipment identification, performance rating, name, or nomenclature plate or data cables
- H. The term "Paint", as used herein, means all coating systems materials including primers, emulsions, epoxy, enamels, sealers, fillers and other applied materials whether used a prime, intermediate, or finish coats.

1.02 RELATED REFERENCES

- A. Work under this section depends on applicable provisions from other sections and the plan set in this contract.

1.03 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product data: Submit manufacturer's technical information and application instructions for each material proposed for use.
- C. Samples: Provide two samples of each color and each gloss for each material on which the finish is specified to be applied.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years documented experience.
- C. Before painting is started in any area, broom clean and remove excessive dust. After painting has begun in any given area, broom cleaning will not be allowed; Cleaning shall then be done only with commercial vacuum cleaning equipment.
- D. Provide adequate illumination in all areas where painting operations are in progress.
- E. VOC Content: Determine VOC (Volatile Organic Compound). Paints and coatings used on the interior of the building (defined as inside of the weatherproofing system and applied on-site) shall comply with the following criteria:
 - 1. Architectural paints, coatings and primers applied to interior walls and ceilings: Do not exceed the VOC content limits established in Green Seal Standard GS-11, Paints, First Edition, May 20, 1993. Primers must meet the VOC limit for non-flat paint.

- a. Flats: 50 g/L
 - b. Non-Flats: 150 g/L
2. Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates: Do not exceed the VOC content limit of 250 g/L established in Green Seal Standard GS-03, Anti-Corrosive Paints, Second Edition, January 7, 1997.
3. Clear wood finishes, floor coatings, stains, and shellacs applied to interior elements: Do not exceed the VOC content limits established in South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, rules in effect on January 1, 2004. The following list of SCAQMD VOC limits are examples. Refer to the standards for complete details.
 - a. Clear wood finishes: varnish 350 g/L; lacquer 550 g/L
 - b. Floor coatings: 100 g/L
 - c. Sealers: waterproofing sealers 250 g/L; sanding sealers 275 g/L; all other sealers 200 g/L
 - d. Shellacs: Clear 730 g/L; pigmented 550 g/L
 - e. Stains: 250 g/L

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver products all materials to the project site in original, new and unopened containers bearing the manufacturer's name and label showing the following information:
 1. Manufacturer name; type of material
 2. Thinning and mixing instructions
 3. Manufacturer's stock number and batch number
 4. Application instructions
 5. Color: Name and Number
 6. Contents by volume of major pigment and vehicle constituents
- B. Paint materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area and as required by manufacturer's instructions.
- C. Store all materials used on the project in protected areas designated by the City Project Manager. Keep storage neat and clean. Remove used rags, waste and trash from the building every night and take every precaution to avoid the risk of fire.

1.06 ATTIC STOCK

- A. Upon completion of the work of this section, deliver to the project site, attic stock from the same production run, identified with labels. Paint to be factory sealed and not less than one gallon of each material applied. All stock to be inventoried and neatly located in an area designated by the project manager and provide inventory list to the project manager.

1.07 GUARANTEE

- A. Work and materials in this section shall be guaranteed to be free from defects for a period of one (1) year from date of final completion of project.
- B. Any defects, not due to or caused by faulty construction or material furnished or performed by other crafts, but due to defective materials and workmanship in painting and finishing, shall be repaired and corrected by the Painting Contractor without cost to the Owner.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
- B. All paint and cleaners shall be low VOC type.
- C. MANUFACTURERS:
 1. Hallman Lindsay,
 2. Pittsburgh Paints,
 3. Sherwin-Williams,
 4. Diamond Vogel,

- 5. Benjamin Moore
- D. Provide scuff-resistant paint as scheduled.
- E. COLORS AND GLOSSES: Owner will select colors to be used in the various types of paint specified and will be the sole judge of acceptability of the various glosses obtained from materials proposed to be used by the Contractor.
- F. UNDERCOATS AND THINNERS: Provide undercoat paint produced by the same manufacturer as the finish coat. Use only the thinners recommended by the paint manufacturer, and use only to the recommended limits. In so far as practical, use undercoat, finish coat, and thinner material as parts of a unified system of paint finish.

2.02 APPLICATION EQUIPMENT

- A. Use only such equipment as is recommended for application of the particular paint by the paint manufacturer.
- B. Include all required ladders, scaffolding, drop clothes, masking, scrapers, tools, dusters, cleaning solvents, and waste, as required to perform the work.

2.03 COLORS

- A. BASE COLOR THROUGHOUT: As indicated on drawings.
- B. ACCENT COLOR: As indicated on drawings.
- C. HM DOORS & FRAMES: As indicated on drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Before starting any work, carefully examine surfaces to receive paint finishes for defects which cannot be corrected by the procedures specified herein under "Preparation of Surfaces" and which might prevent satisfactory painting results. Do not proceed until such damages are corrected. The commencing of work in a specific area shall be construed as acceptance of the surfaces, and thereafter the painting contractor shall be fully responsible for satisfactory work as required herein.

3.02 PREPARATION OF SURFACES

- A. Remove or mask hardware, accessories, device plates, lighting fixtures, factory finished work and similar items or provide ample in-place protection. Upon completion of each space, carefully replace all removed items.
- B. Clean and prepare surfaces to be painted in accordance with the manufacturer's instruction for each particular substrate condition and as specified. Remove oil and grease prior to cleaning.
- C. Seal surfaces that might cause bleed through or staining of topcoat.
- D. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- E. Masonry
 - 1. Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions
- F. Gypsum Board
 - 1. Repair/patch irregularities with filler compound. Sand to a smooth level surface. Use tack cloth to remove dust and particles. Spot prime defects after repair and texture to match existing.
- G. Metal doors and frames
 - 1. Clean and sand shoulders at edge of sound paint; Touch up all bare metal with primer.

3.03 APPLICATION

- A. Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.
- B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
- C. Apply materials under adequate illumination, evenly spread and flowed on smoothly to avoid runs, sags, brush marks, air bubbles, excessive roller stipple or other surface imperfections. Cut in sharp lines and color breaks.
- D. Apply materials at not less than the manufacture's recommended spreading rate. Provide a total dry film thickness of the entire system as recommended by the manufacturer.
- E. Coverage and hide shall be complete. When color, stain, dirt or undercoats show through final coat of paint, the surface shall be covered by additional coats until the paint film is of uniform finish, color, appearance and coverage, at no additional cost to the Owner.
- F. Paint metal doors interior faces to the suite, including, top, bottom and side edges to match.

3.04 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B. At end of each workday, remove empty cans, rags, trash and other discarded paint materials from the project site.
- C. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- D. Provide "Wet Paint" signage to protect newly painted surfaces.

3.05 PAINT AND COATING SCHEDULE

- A. Surfaces to be painted as indicated on the drawings.
- B. Interior Gypsum Board Surfaces to be painted:
 - 1. One topcoat: Interior Eggshell Latex with the exception of the following:
 - a. Restrooms, Breakrooms and Locker Rooms shall have Latex Semi-Gloss finish.
- C. Metal Surfaces to be painted including but not limited to doors and door frames
 - 1. One topcoat: Verify
- D. Interior CMU and concrete to be painted:
 - 1. One topcoat: Interior Eggshell Latex

END OF SECTION

**SECTION 10 11 00
VISUAL DISPLAY UNITS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Porcelain enamel steel markerboards.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Blocking and supports.
- B. Section 09 21 16 - Gypsum Board Assemblies: Concealed supports in metal stud walls.
- C. Section 09 22 16 - Non-Structural Metal Framing: Concealed supports in metal stud walls.

1.03 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2018.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide manufacturer's data on chalkboard, porcelain enamel steel markerboard, glass markerboard, tackboard, tackboard surface covering, trim, and accessories.
- C. Shop Drawings: Indicate wall elevations, dimensions, joint locations , special anchor details.
- D. Samples: Color charts for selection of color and texture of porcelain enamel steel markerboard and trim.
- E. Manufacturer's printed installation instructions.
- F. Maintenance Data: Include data on regular cleaning, stain removal .

1.05 QUALITY ASSURANCE

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

1.06 WARRANTY

- A. See Section 01 77 00-Closeout Procedures, for additional warranty requirements.

PART 2 PRODUCTS

2.01 VISUAL DISPLAY UNITS

- A. Porcelain Enamel Steel Markerboards :
 - 1. Manufacturers:
 - a. AJW Architectural Products: www.ajw.com/#sle.
 - b. ASI Visual Display Products: www.asi-visualdisplayproducts.com/#sle.
 - c. Claridge Products and Equipment, Inc: www.claridgeproducts.com/#sle.
 - d. Nelson Adams NACO: www.nelsonadamsnaco.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Color: White.
 - 3. Steel Face Sheet Thickness: 24 gauge, 0.0239 inch (0.61 mm).
 - 4. Core: Particleboard, manufacturer's standard thickness, laminated to face sheet.
 - 5. Backing: Aluminum sheet, laminated to core.
 - 6. Size: As indicated on drawings.

2.02 MATERIALS

- A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.

- B. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.
- C. Aluminum Sheet Backing: 27 gauge, 0.014 inch (0.36 mm) thick.
- D. Adhesives: Type used by manufacturer.

2.03 ACCESSORIES

- A. Temporary Protective Cover: Sheet polyethylene, 8 mil (0.2 mm) thick.
- B. Marker Tray: Aluminum, manufacturer's standard profile, one piece full length of markerboard, molded ends, concealed fasteners, same finish as frame.
- C. Mounting Brackets: Concealed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.
- C. Verify flat wall surface for frameless adhesive-applied boards.

3.02 PREPARATION

- A. Acclimatize tackable wall panels by removing from packaging in installation area not less than 24 hours before application.
- B. Remove switchplates, wall plates, and surface-mounted fixtures where tackable wall paneling is applied. Reinstall items on completion of installation.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install boards in accordance with manufacturer's instructions.
- B. Install with top of marker tray at a height above finished floor as indicated on the drawings.
- C. Secure units level and plumb.

3.04 CLEANING

- A. Clean board surfaces in accordance with manufacturer's instructions.
- B. Cover with protective cover, taped to frame.
- C. Remove temporary protective cover at Date of Substantial Completion.
- D. Break-in slate chalkboards with a chalk and clean treatment.

END OF SECTION

**SECTION 10 14 00
SIGNAGE****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Room and door signs.
- B. Recognition/Donor panels.
- C. Building identification signs.

1.02 RELATED REQUIREMENTS

- A. Section 26 51 00 - Interior Lighting: Exit signs required by code.
- B. Section 10 14 63 - Electronic Message Signage.

1.03 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines current edition.
- B. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- C. ASTM E2072 - Standard Specification for Photo-luminescent (Phosphorescent) Safety Markings 2014.
- D. ICC A117.1 - Accessible and Usable Buildings and Facilities 2009.
- E. NFPA 170 - Standard for Fire Safety and Emergency Symbols 2021.
- F. UL 1994 - Luminous Egress Path Marking Systems Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - 1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
 - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication, submit preliminary schedule.
 - 3. Submit for approval by Owner through Architect prior to fabrication.
- D. Samples: Submit one sample of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
- E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
- F. Verification Samples: Submit samples showing colors specified.
- G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
- H. Manufacturer's Qualification Statement.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.05 QUALITY ASSURANCE

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

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
-

- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

1.07 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Flat Signs:
 - 1. Best Sign Systems, Inc.
 - 2. FASTSIGNS
 - 3. Inpro
 - 4. Takeform
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Dimensional Letter Signs:
 - 1. FASTSIGNS.
 - 2. Inpro
 - 3. Takeform
 - 4. Substitutions: See Section 01 60 00 - Product Requirements

2.02 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
 - 1. Sign Type: Flat signs with injection molded panel media as specified.
 - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch (0.8 mm) and Grade II braille.
 - 3. Character Height: 1 inch (25 mm)
 - 4. Sign Height: 6" minimum, unless otherwise indicated.
 - 5. Office Doors: Identify with the room names and numbers indicated on drawings; in addition, provide "window" section for replaceable occupant name and braille.
 - 6. Conference, Meeting Rooms, Community Room, Class Room & Pavilion: Identify with the room names and numbers indicated on drawings and braille.
 - a. Include Room Schedulers per Sign Schedule on drawings.
 - 7. Service Rooms: Identify with the room names and numbers indicated on drawings and braille.
 - 8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN" restrooms 154A and 154B only Restroom on all others, room numbers indicated on the drawings and braille.
 - 9. Staff Only; refer to drawings and schedule for vinyl door graphic
 - 10. Stacks; Dewey Decimal guide signs on end of stacks. Numbers to be determined.
- C. Recognition/Donor Panels: Engraved panel media; individual name signs attached with magnetic tape to fixed panel.
 - 1. Dimensions and Number of Name Signs: To be determined.
 - 2. Provide all name signs whether engraved or not, for uniform overall appearance.
 - 3. Color: To be determined
- D. Building Information Signs:
 - 1. Type:
 - a. No Smoking with City of Madison Ordinance.
 - b. No Weapons with City of Madison Ordinance.

2. Mount on outside wall and/or glazing in location indicated on drawings.
- E. Other Dimensional Letter Signs: Wall-mounted.
 1. Interior: As indicated on drawings and schedule. Letters, 8 inches (150 mm) high, plastic.

2.03 SIGN TYPES

- A. Flat Signs: Refer to drawings for basis of design.
 1. Edges: Square.
 2. Corners: Square.
 3. Wall Mounting of One-Sided Signs: Tape adhesive; Concealed screws.
 4. Suspended Mounting: Stainless steel suspension cables, cable clamps, and ceiling fastener suitable for attachment to ceiling construction indicated.

2.04 TACTILE SIGNAGE MEDIA

- A. Injection Molded Panels: One-piece acrylic plastic, with raised letters and braille.
 1. Product: Refer to drawings for basis of design
 2. Total Thickness: 1/8 inch (3 mm)

2.05 DIMENSIONAL LETTERS

- A. Plastic Letters:
 1. Material: Injection molded plastic or Formed plastic
 2. Color: To be determined
 3. Mounting: Concealed screws

2.06 ACCESSORIES

- A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
- B. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- D. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

END OF SECTION

SECTION 10 14 14 EXTERIOR SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Illuminated Channel Letter Signage – “LIBRARY” “PARK PAVILION”
- B. Illuminated Channel Letter Signage – Library Logo Icon
- C. Illuminated Ground Monument Sign.

1.02 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. UL 879 - Electric Sign Components; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate "Work by Others" that is required for sign installation with the General Contractor and their Subcontractors.
- B. Preinstallation Meetings: Review sequencing and schedule with General Contractor and their subcontractors 3 weeks prior to installation.
- C. Sequencing: Install signage after the majority of the project is completed, but before final landscaping is installed.
- D. Scheduling: Schedule installation with the General Contractor.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Shop Drawings:
 - 1. Include dimensions, locations, elevations, materials, text and graphic layout, attachment details, and schedules.
 - 2. Show locations of electrical service connections.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Verification Samples: Submit samples showing colors, materials, and finishes specified.
- D. Fabricator's Installation Instructions: Include installation templates and attachment devices.
- E. Fabricator's qualification statement.
- F. Installer's qualification statement.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements for additional provisions.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating products specified in this section, with at least three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- C. Documents at Project Site: Maintain at project site one copy of manufacturer's instructions, erection drawings, and shop drawings.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
 - B. Package signs as required to prevent damage before installation.
-

- C. Store under cover and elevated above grade.

1.07 FIELD CONDITIONS

- A. Existing Conditions: See site and utility survey, geotechnical report, hazardous material survey, existing conditions survey, and site drawing; see Section 00 31 00.
- B. Do not install during inclement weather.
- C. Do not install when exterior temperatures are not within the recommended range for the sealant used on the project.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Installer Warranty: Provide 2-year warranty for workmanship commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with installer.
- C. Finish Warranty: Provide 5-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.
- D. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.

2.02 EXTERIOR, DIRECT MOUNTED, ILLUMINATED CHANNEL LETTER SIGNAGE

- A. Applications: 1 count each **LIBRARY; PARK PAVILION**
 - 1. Individually Mounted Channel letters, no raceways or cabinet backers.
 - 2. Mounting Location: Exterior as indicated on drawings.
 - 3. Material: Aluminum Returns/Backers. Trimcap. Translucent Acrylic Faces.
 - 4. Thickness: 2" Overall Depth, Directly mounted to wall surface.
 - 5. Letter Height: See drawings for spec.
 - 6. Text and Typeface:
 - a. Character Font: Gotham
 - 7. Finish: Satin
 - 8. Color: Matching White trimcap and returns.
 - 9. Mounting: Concealed.
- B. Accessories:
 - 1. Concealed Screws: Noncorroding metal or stainless steel
 - 2. Wall Penetrations: Must be sealed fully with silicone.
- C. Attic Stock:
 - 1. Include attic stock for "**LIBRARY**" Channel Letters as follows:
 - a. (2 ct) **L**
 - b. (1 ct) **I**
 - c. (1 ct) **B**

2.03 EXTERIOR DIRECT MOUNTED, ILLUMINATED CHANNEL LETTER LOGO

- A. Applications: 1 count each **LIBRARY LOGO ICON**
 - 1. Individually Mounted Channel letters, no raceways or cabinet backers.
 - 2. Mounting Location: Exterior as indicated on drawings.
 - 3. Material: Aluminum Returns/Backers. Trimcap. Translucent Acrylic Faces.
 - 4. Thickness: 2" Overall Depth, Directly mounted to wall surface.

5. Letter Height: Varies. See drawings for spec.
6. Text and Typeface:
 - a. Character Font: Gotham
7. Finish: Satin
8. Color: Faces, trimcap and returns to match spec on drawings.
9. Mounting: Concealed.

B. Accessories:

1. Concealed Screws: Noncorroding metal or stainless steel
2. Wall Penetrations: Must be sealed fully with silicone.

2.04 EXTERIOR GROUND MOUNTED, ILLUMINATED MONUMENT SIGN

A. Applications: 1 count Monument Sign

1. Double-Faced, Ground Mounted Monument with GC provided Concrete Base.
2. Mounting Location: Final Mounting Location TBD.
3. Material: Exposed Concrete Base, Aluminum Cabinets, Brushed aluminum accents. Acrylic lettering (various thickness).
4. Dimensions: See Drawings.
5. Letter Height: Varies, see drawings for spec.
6. Text and Typeface: Main (Imagination Center) – Routed with $\frac{3}{4}$ " Push-Through, translucent white Acrylic. Sub- Copy/logos – Routed/backed with $\frac{1}{8}$ " translucent white acrylic.
7. Character Font: Gotham (Imagination Center). Logos are owner provided vector files.
8. Finish: Satin
9. Color: See Drawing for spec.
10. Mounting: Per Drawings.

B. Accessories:

1. Concealed Screws: Noncorroding metal or stainless steel
2. Penetrations: Must be sealed fully with silicone.

PART 3 EXECUTION

3.01 PERMITTING

- A. All signs require City of Madison Urban Design Commission (UDC) approval prior to start of production.
- B. All signs require City of Madison sign permit prior to installation.
- C. Procurement of municipal permits and approvals by selected signage vendor

3.02 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify that electrical service is correctly sized and located to accommodate Channel letter signage.
- C. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's written instructions.
- B. Install square and level in accordance with all mounting surfaces.
- C. Coordinate installation with General Contractor and Electrical Contractor based on construction schedule.

3.04 REPAIR

- A. Repair or replace damaged items.

3.05 CLEANING

- A. See Section 01 77 00-Closeout Procedures for additional requirements.
- B. Clean installed signage per manufacturer's recommendations.
- C. Clean up and remove all debris created by installation process.

3.06 PROTECTION

- A. Protect installed signage from subsequent construction operations.

END OF SECTION

**SECTION 10 14 63
ELECTRONIC MESSAGE SIGNAGE**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Indoor light emitting diode signage. (LED)

1.02 RELATED SECTIONS

- A. Section 10 14 00 - Signage.
- B. Division 26 – Electrical.
- C. Division 27 – Communications.

1.03 REFERENCES

- A. Federal Communications Commission (FCC):
 - 1. FCC Part 15 Class A/Class B Complaint.
- B. Underwriters Laboratories (UL):
 - 1. UL48, CUL48, - Standard for Electric Signs.
 - 2. UL Energy Efficiency Verified (Green Leaf certification).
- C. National Electric Code (NEC).
- D. International Building Code (IBC): IBC Standards.
- E. Intel and Digital Content Protection LLC: HDCP 2.x compliant.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 - Submittals.
- B. Upon contract award, the LED display manufacturer shall provide a complete technical submittal within 60 days and shall not proceed with manufacturing until approval.
- C. Product Data:
 - 1. Manufacturer's data sheets on each product to be used.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Site power requirements.
 - 5. LED display installation drawing.
 - 6. LED display installation manual.
 - 7. LED display control software operator's manual.
 - 8. LED display installation and maintenance manual.
- D. Shop Drawings: Include details of materials, construction, and finish. Include relationship with adjacent construction.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing Work of this section with minimum two years documented experience with projects of similar scope and complexity.
- B. Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity.

1.06 PRE-INSTALLATION CONFERENCE

- A. Convene a conference approximately two weeks before scheduled commencement of the Work. Attendees shall include Architect, Contractor and trades involved. Agenda shall include schedule, responsibilities, critical path items and approvals.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle in strict compliance with manufacturer's written instructions and recommendations.
-

- B. Protect from damage due to weather, excessive temperature, and construction operations.

1.08 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.09 WARRANTY

- A. Manufacturer's standard limited warranty unless indicated otherwise.
1. Toll-free service coordination.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: View Sonic Corporation.; <https://www.ViewSonic.com>
Phone: 888.881.8781
Email: salesinfo@viewsonic.com
- B. Requests for substitutions will be considered in accordance with the provisions of Section 01 60 00.

2.02 LED INDOOR DISPLAY

- A. Basis of Design: ViewSonic EP1042T Multimedia Digital Poster
All-in-one interactive digital ePoster for advertising and branding, room scheduler, interactive signage for conference and meeting rooms, and wayfinding.
1. Model VS16289:
Technical Attributes:
 - a. Screen Size: 10.1 inches (256.54 mm).
 - b. Panel Resolution: 1280 x 800.
 - c. Light Source: LED (Backlight).
 - d. Static Contrast Ratio: 800:1.
 - e. Power-over-ethernet (PoE), 13W.
 - B. Features: General.
 1. Orientation: Portrait or Landscape.
 2. Viewing Angle: Vertical: 185 degrees. Horizontal: 85 degrees.
 3. Compliance Information: ETL 60950; RoHS; CE; FCC Part 15 regulations for Class A devices, HDCP 2.x.
 4. Software:
 - a. Proprietary, Signage Manager Express;
 - b. Compatible with third-party software.
 5. User Interface: Multi-touch widescreen LCD display; Web application and controller interface.
 6. Built-in embedded antenna b/g/n 2.4GHz network, Bluetooth, Ethernet.
 7. Built-in camera.
 8. Input: USB, Micro SD.
 9. Output: HDMI, 3.5mm Audio Jack.
 10. Built-in stereo speakers.
 11. Mount options:
 - a. VESA wall mount (MIS-D75); Screw spec: M4*4mm. Recommended for better air flow.
 - b. Back cover wall mount.
 - c. Back cover table stand mount.
 12. Power Source:
 - a. AC Adaptor: 120 VAC, 60 Hz single-phase, including neutral and ground.
 - b. Power-over-ethernet, 13W.

PART 3 EXECUTION**2.01 EXAMINATION**

- A. Do not begin installation until the substrates have been properly constructed and prepared.
 - 1. Mounting Supports: To be installed to support displays.
 - 2. Separate Conduit for Power and Data to Display: To be in place unless fiber is being used. Verify control equipment has access to 120/240 VAC.
- B. If substrate preparation is the responsibility of another installer, notify Architect in writing of unsatisfactory preparation before proceeding.

2.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

2.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions, approved submittals, and in proper relationship with adjacent construction.
 - 1. The Contractor:
 - a. Is responsible for ensuring the structure and mounting hardware are adequate.
 - b. Is responsible for ensuring that the installation meets local standards.
 - 2. Mounting Hardware: To be capable of supporting components to be mounted.
 - 3. Possible power and signal entrances are designated by etched markings.
 - a. Separate conduit must be used to route the power, and data cables.
 - 4. Displays must be grounded according to the provisions outlined in Article 250 of the National Electrical Code.
 - 5. Installations are to conform to Article 600 of the National Electrical Code.

2.04 FIELD QUALITY CONTROL

- A. Field Inspection: Coordinate field inspection in accordance with appropriate sections in Division 01.

2.05 CLEANING AND PROTECTION

- A. Clean products in accordance with the manufacturer's recommendations.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 10 21 13.17
PHENOLIC TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Phenolic toilet compartments.
- B. Urinal and vestibule screens.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Blocking and supports.
- B. Section 10 28 00 - Toilet, Bath, and Laundry Accessories.

1.03 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- B. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide data on panel construction, hardware, and accessories.
- C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
- D. Samples: Submit two samples of partition panels, 4 by 4 inch (102 by 102 mm) in size illustrating panel finish, color, and sheen.
- E. Manufacturer's Installation Instructions: Indicate special procedures.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Phenolic Toilet Compartments:
 - 1. Bradley Corporation: www.bradleycorp.com/#sle.
 - a. Phenolic Series 700, High Density Polyethylene (HDPE)
 - 2. Substitutions: Section 01 60 00 - Product Requirements.

2.02 PHENOLIC TOILET COMPARTMENTS

- A. Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid phenolic core panels with integral melamine finish, floor-to-ceiling.
 - 1. Color: As selected by Architect from manufacturer's standard options..
 - B. Doors:
 - 1. Thickness: 1 inch (25 mm).
 - 2. Width: 24 inch (610 mm), in-swinging for standard toilet compartments
 - 3. Width for Handicapped Use: 36 inch (915 mm), out-swinging, with 32 inch wide clear opening
 - 4. Height: 58 inch (1473 mm).
 - C. Panels:
 - 1. Thickness: 1 inch (25 mm).
 - 2. Height: 58 inch (1473 mm).
 - 3. Depth: As indicated on drawings.
-

- D. Pilasters:
 - 1. Thickness: 1 inch (25 mm).
 - 2. Width: As required to fit space; minimum 3 inch (76 mm).
- E. Urinal Screens: Without doors; to match compartments; mounted to wall with one continuous panel bracket.
 - 1. Thickness: [1] inch ([25] mm).
 - 2. Height: as indicated on the drawings.
 - 3. Depth: as indicated on the drawings.

2.03 ACCESSORIES

- A. Pilaster Shoes: Formed ASTM A666 Type 304 stainless steel with No. 4 finish, 4 inch (100 mm) high, concealing floor fastenings.
 - 1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
 - 2. Provide ceiling attachment using two adjustable hanging studs, attached to above-ceiling framing.
- B. Wall and Pilaster Brackets: Polished stainless steel; continuous type.
- C. Attachments, Screws, and Bolts: Stainless steel , tamper proof type.
- D. Hardware: Polished stainless steel:
 - 1. Continuous hinges, adjustable to hold door open at any angle up to 90 degrees.
 - 2. Door Latch: Slide type with exterior emergency access feature, surface mounte
 - 3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
 - 4. Coat hook with rubber bumper; one per compartment, mounted on door. Sized to prevent door from hitting compartment-mounted accessories.
 - 5. Provide door pull for outswinging doors, both side of door at accessible compartments.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 inch to 1/2 inch (9 mm to 13 mm) space between pilaster and panels and not more than 1 inch (25 mm) between wall and panels.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets.
- E. Use theft-resistant exposed fasteners finished to match hardware. Use Sleeve nuts for through-bolt applications.
 - 1. Stirrup Brackets: Align brackets and pilasters with brackets at walls. Locate full length continuous wall brackets leve and swaure so holes for anchors occur in masonry or tile joints.
 - 2. Set hinges on in-swinging doors to hold open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and swing door entrance screens to return to fully closed position.
- F. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.03 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch (6 mm).
- B. Maximum Variation From Plumb: 1/8 inch (3 mm).

3.04 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch (5 mm).
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

**SECTION 10 22 39
FOLDING PANEL PARTITIONS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Top-supported folding panel partitions, horizontal opening.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood blocking and track support shimming.
- B. Section 08 71 00 - Door Hardware: Lock cylinders for panels
- C. Section 26 05 33.13 - Conduit for Electrical Systems: Empty conduit from partition motor controller to disconnect and from motor controller to control buttons.
- D. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections; control buttons .

1.03 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- C. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- D. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
- E. ASTM E413 - Classification for Rating Sound Insulation; 2022.
- F. ASTM E557 - Standard Guide for Architectural Design and Installation Practices for Sound Isolation Between Spaces Separated by Operable Partitions; 2012 (Reapproved 2020).
- G. ASTM F793/F793M - Standard Classification of Wall Coverings by Use Characteristics; 2020.
- H. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2020.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene at project site seven calendar days prior to scheduled beginning of construction activities of this section to review section requirements.
 - 1. Require attendance by representatives of installer.

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
 - B. Product Data: Provide data on partition materials, operation, hardware and accessories, electric operating components, track switching components, and colors and finishes available.
 - C. Design Data: Design calculations, bearing seal and signature of structural engineer licensed to practice in the State in which the Project is located, showing loads at points of attachment to the building structure.
 - D. Shop Drawings: Indicate opening sizes, track layout, details of track and required supports, static and dynamic loads, location and details of pass door and frame, adjacent construction and finish trim, and stacking depth.
 - E. Samples for Review: Submit two samples of surface finish, 12 by 12 inches (300 by 300 mm) size, illustrating quality, colors selected, texture, and weight.
 - F. Certificates: Certify that partition system meets or exceeds specified acoustic requirements.
 - G. Manufacturer's Instructions: Indicate special procedures.
-

- H. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods. Describe cleaning materials detrimental to finish surfaces and hardware finish.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until installation.

1.08 WARRANTY

- A. See Section 01 77 00-Closeout Procedures, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Folding Panel Partitions - Horizontal Opening:
1. Modernfold, a DORMA Group Company: www.modernfold.com/#sle.
 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 FOLDING PANEL PARTITIONS - HORIZONTAL OPENING

- A. Folding Panel Partitions: Center opening; paired panels; side stacking; motor operated.
1. Basis of Design: Acousti-seal Encore Paired Panel, STC 56 by Modernfold
- B. Panel Construction:
1. Panel Properties:
 - a. Thickness With Finish: 4 inches (100 mm).
 - b. Width: Equal widths.
 - c. Weight: 12 lb/sq ft (59 kg/sq m).
- C. Panel Finishes:
1. Facing: As selected from Manufacturer's standard finish options.
 2. Exposed Metal Trim: Clear anodized.
- D. Panel Seals:
1. Modernfold Sure Set Automatic System: Top and Bottom
 2. Panel to Panel Seals: Grooved and gasketed astragals, with continuous flexible ribbed vinyl seal fitted to panel edge construction; color to match panel finish.
 3. Acoustic Seals: Flexible acoustic seals at jambs, meeting mullions, ceilings, floor and ceiling seals, and above track to structure acoustic seal.
- E. Suspension System:
1. Modernfold Smart Track suspension system
- F. Performance:
1. Acoustic Performance:
 - a. Sound Transmission Class (STC): Equal to or greater than 55 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90, on panel size of 100 sq ft (9.3 sq m).
 2. Installed partition system track capable of supporting imposed loads, with maximum deflection of 1/360 of span.
- G. Operation:
1. Electric Operator: 12 inches (300 mm) per second traveling speed; adjustable friction clutch brake actuated by solenoid controlled motor starter; enclosed limit switch; enclosed magnetic reversing starter.

2. Control Station: One standard keyed, three button OPEN-STOP-CLOSE type; 24 volt circuit; surface mounted.
 - a. Location to be determined
 - b. Key switch prepared for mortise lock cylinder.
 - c. Key switches alike.
 3. Safety Features:
 - a. Limit Switches: Automatic type, at both extremes of travel, to prevent over-travel.
 - b. Emergency Release: Mechanism to disengage motor drive system and permit manual operation.
 - c. Pocket Door Interlock: Mechanism to prevent operation of panels unless storage pocket doors are fully open.
 4. Electrical Requirements:
 - a. See Manufacturer recommendations for motor size required for specified panel system.
 - b. Disconnect Switch: Factory mount disconnect switch in control panel.
- H. Accessories:
1. Pocket Enclosures: Door, frame, and trim to match adjacent panels.

2.03 MATERIALS

- A. Aluminum Extrusions: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- B. Vinyl Coated Fabric: ASTM F793 Category VI, polyvinyl fluoride (PVC) finish for washability and improved flame retardance; color as selected by Architect from manufacturer's standard range.
- C. Hardwood Plywood: Face species Beech, plain sliced, book matched, veneer core; HPVA HP-1, Front Face Grade AA, Back Face Grade 1; glue type as recommended for application.
- D. Particleboard: ANSI A208.1; composed of wood chips, sawdust, or flakes of medium density, made with waterproof resin binders; of grade to suit application; sanded faces.
- E. Acoustic Insulation:
 1. Type: As required for acoustic performance indicated.
 2. Thickness: As required for acoustic performance indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that required utilities are available, of the correct characteristics, in proper location, and ready for use.
- C. Verify track supports are laterally braced and will permit track to be level within 1/4 inch (6.4 mm) of required position and parallel to the floor surface.
- D. Verify floor flatness of 1/8 inch in 10 feet (3 mm in 3 m), non-cumulative.
- E. Verify wall plumbness of 1/8 inch in 10 feet (3 mm in 3 m), non-cumulative.

3.02 INSTALLATION

- A. Install partition in accordance with manufacturer's instructions and ASTM E557.
- B. Fit and align partition assembly level and plumb.
- C. Lubricate moving components.
- D. Install acoustic sealant to achieve required acoustic performance.

3.03 ADJUSTING

- A. Adjust partition assembly to provide smooth operation from stacked to full open position. Do not over-compress acoustic seals.
- B. Visually inspect partition in full extended position for light leaks to identify a potential acoustical leak.

- C. Adjust partition assembly to achieve lightproof seal.

3.04 CLEANING

- A. Clean finish surfaces and partition accessories.

3.05 CLOSEOUT ACTIVITIES

- A. Demonstrate operation of partition and identify potential operational problems.

END OF SECTION

**SECTION 10 26 00
WALL AND DOOR PROTECTION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Corner guards.
- B. Protective wall covering.
- C. Chair rails.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Blocking for wall and corner guard anchors.
- B. Section 09 21 16 - Gypsum Board Assemblies: Placement of supports in stud wall construction.
- C. Section 09 22 16 - Non-Structural Metal Framing: Placement of supports in stud wall construction.
- D. Section 09 72 00 - Wall Coverings: Terminating wall covering at wall and door protection.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- B. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics 2023, with Editorial Revision.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023c.
- D. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2022.
- E. ICC A117.1 Accessible and Usable Buildings and Facilities 2009.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Shop Drawings: Include plans, elevation, sections, and attachment details.
- C. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.
 - 1. Submit two; sections of corner guards 6 inches long.
 - 2. Submit two; samples of protective wall covering 6 by 6 inches square.
- D. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special attention.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions
 - 2. Extra Stock Materials: Two corner guards; 48" long.
 - 3. Extra Stock Materials: 200 square feet of Palladium Rolled wall protection.
- G. Maintenance Data: Manufacturer's instructions for care and cleaning of each type of product. Include information about both recommended and potentially detrimental cleaning materials and methods.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.
 - B. Protect work from moisture damage.
 - C. Protect work from UV light damage.
 - D. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in compliance with manufacturer's recommendations for each type of item.
-

- E. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

1.06 WARRANTY

- A. See Section 01 77 00-Closeout Procedures for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Corner Guards
1. Inpro Enviro GT Stainless Steel; www.inprocorp.com
- B. Protective Wall Covering:
1. Inpro Rolled Palladium Rigid Sheet; www.inprocorp.com
 2. Inpro Aspex Printed Wall Protection; www.inprocorp.com
 3. Excess Sheet Material.

2.02 PERFORMANCE CRITERIA

- A. Impact Strength: Unless otherwise noted, provide protection products and assemblies that have been successfully tested for compliance with applicable provisions of ASTM D256 and/or ASTM F476.
- B. Chemical and Stain Resistance: Unless otherwise noted, provide protection products and assemblies with chemical and stain resistance complying with applicable provisions of ASTM D543.
- C. Fungal Resistance: Unless otherwise noted, provide protection products and assemblies which pass ASTM G21 testing.

2.03 PRODUCT TYPES

- A. Corner Guards - Flush Mounted:
1. Material: Type 430; stainless steel, No. 4; satin finish, 16 gauge.
 2. Performance: Resist lateral impact force of 100 lbs (445 N); at any point without damage or permanent set.
 3. Fire Resistance: Where fire rating is specified for the wall in which the guard is mounted, provide assemblies that have been tested in accordance with ASTM E119 for the same rating as the wall.
 4. Width of Wings: 1/2" inches
 5. Corner: Square
 6. Color: As indicated on drawings.
 7. Length: One piece.
 8. Cut to length to align with wall protection where applicable.
 9. Mounting: Countersunk screws through factory-drilled holes; Clear adhesive; Translucent double-faced, factory-applied tape
- B. Protective Wall Panels:
1. Material: Palladium Rigid Sheet
 2. Thickness: .030; 4'x50' roll
 3. Material: Aspex printed wall protection. Final printed coordinated during submittal process.
 4. Thickness: .040 inch; 4'x10'
 5. Surface Burning Characteristics: Provide assemblies with flame spread index and smoke developed index in accordance with ASTM E84.
 6. Color and Pattern: Palladium: Feather 0238; Aspex: clear with back print
 7. Texture: As selected from manufacturer's standard textures
 8. Accessories: Provide manufacturer's standard color-matched; trim and moldings.
 9. Outside Corner Trim: Flat
 10. Mounting: Adhesive.
- C. Chair Rails:
1. Material: excess sheet material as indicated on the drawings.

2. Thickness, Color, Pattern, Texture: as indicated on the drawings.
3. Location, dimensions: as indicated on the drawings.

2.04 FABRICATION

- A. Fabricate components with tight joints, corners and seams.
- B. Pre-drill holes for attachment.
- C. Form end trim closure by capping and finishing smooth.

2.05 SOURCE QUALITY CONTROL

- A. See Section 01 45 16-Field Quality Control Procedures for City of Madison requirements.
- B. Provide wall and door protection systems of each type from a single source and manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that field measurements are as indicated on drawings
- C. Verify that substrate surfaces for adhered items are clean and smooth.
 1. Test painted or wall covering surfaces for adhesion in inconspicuous area, as recommended by manufacturer. Follow adhesive manufacturer's recommendations for remedial measures at locations and/or application conditions where adhesion test's results are unsatisfactory.
- D. Start of installation constitutes acceptance of project conditions.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.
- B. Position corner guard 4 inches above finished floor to 52 inches high unless otherwise noted on plan.
- C. Coordinate installation of rigid wall protection with corner guard
 1. Position protective wall covering 36" A.F.F. scribe to floor. Salvage 12 inch waste for use as chair rail.
 2. Wainscot Installation: Establish a level line at the specified height for entire length of run. Install by aligning top of edge of covering with this line.
 3. Apply adhesive with 1/8 inch (3.2 mm) V-notch trowel to an area of wall surface that can be completed within cure time of the adhesive.
 4. Install trim pieces as required for a complete installation. Allow tolerance for thermal movement.
 5. At joints indicated to be caulked, allow for a minimum 1/16 inch (1.6 mm) wide gap between edges of sheets. Gaps are required to be of consistent width throughout the project.
 6. Use a roller to ensure maximum contact with adhesive.
 7. At inside and outside corners cut covering sheets to facilitate installation of trim pieces or corner guards.

3.03 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch (6 mm)
- B. Maximum Variation From Level or Plane For Visible Length: 1/8 inch (6 mm)

3.04 CLEANING

- A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

3.05 SCHEDULE

- A. Refer to coded wall finish plan and schedule.

END OF SECTION

SECTION 10 28 00
TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Commercial toilet accessories.
- B. Commercial shower and bath accessories.
- C. Healthcare accessories.
- D. Electric hand/hair dryers.
- E. Diaper changing stations.
- F. Utility room accessories.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Blocking and supports.
- B. Section 08 83 00 - Mirrors
- C. Section 09 30 00 - Tiling: Ceramic washroom accessories.
- D. Section 10 21 13.17 - Phenolic Toilet Compartments.
- E. Section 10 28 19 - Tub and Shower Enclosures.
- F. Section 22 40 00 - Plumbing Fixtures: Under-lavatory pipe and supply covers.

1.03 ABBREVIATIONS AND ACRONYMS

- A. PETG: Polyethylene Terephthalate Glycol.
- B. OFCI: Owner Furnished-Contractor Installed
- C. OFOI: Owner Furnished-Owner Installed

1.04 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2022.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- E. ASTM B86 - Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings; 2023.
- F. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium; 2017 (Reapproved 2022).
- G. ASTM D4802 - Standard Specification for Poly(Methyl Methacrylate) Acrylic Plastic Sheet; 2016.
- H. ASTM D5047 - Standard Specification for Polyethylene Terephthalate Film and Sheeting; 2017.
- I. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2022.
- J. ICC A117.1-2009 - Accessible and Usable Buildings and Facilities; 2009.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.06 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Commercial Toilet, Shower, and Bath Accessories:
 - 1. AJW Architectural Products: www.ajw.com/#sle.
 - 2. American Specialties, Inc: www.americanspecialties.com/#sle.
 - 3. Bradley Corporation: www.bradleycorp.com/#sle.
 - 4. Georgia-Pacific Professional: www.gppro.com/#sle.
 - 5. Kimberly-Clark Corporation; Kimberly-Clark Professional ICON Collection: www.kcprofessional.com/#sle.
 - 6. Substitutions: Section 01 60 00 - Product Requirements.
- B. Electric Hand/Hair Dryers (HD-01):
 - 1. Basis of Design: Dyson Inc; Dyson Airblade V: www.dyson.com/#sle.
 - 2. Substitutions: Section 01 60 00 - Product Requirements.
- C. Diaper Changing Stations (CS-01):
 - 1. American Specialties, Inc: www.americanspecialties.com/#sle.
 - 2. Bradley Corporation: www.bradleycorp.com/#sle.
 - 3. Diaper Deck & Company: www.diaperdeck.com/#sle.
 - 4. Koala Kare Products: www.koalabear.com/#sle.
 - 5. Safe-Strap Company, Inc: www.diaperdepot.com/#sle.
 - 6. Substitutions: 01 60 00 - Product Requirements.
- D. Provide products of each category type by single manufacturer.

2.02 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
 - 1. Grind welded joints smooth.
 - 2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.
- B. Stainless Steel Sheet: ASTM A666, Type 304.
- C. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
- D. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
- E. Zinc Alloy: Die cast, ASTM B86.
- F. Acrylic Plastic Sheet: ASTM D4802.
- G. PETG Plastic Sheet: ASTM D5047.
- H. Adhesive: Two component epoxy type, waterproof.
- I. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
- J. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.03 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.
-

- B. Chrome/Nickel Plating: ASTM B456, SC 2, satin finish, unless otherwise noted.
- C. Back paint components where contact is made with building finishes to prevent electrolysis.

2.04 COMMERCIAL TOILET ACCESSORIES

- A. Owner Furnished-Contractor Installed (OFCI) Items
 - 1. Owner to provide the manufacturer, model and installation instructions for the accessories identified as OFCI in the Accessory Schedule.
- B. Install ALL wall mounted accessories per mounting height table on the drawings and per ICC A117.1.
- C. Grab Bars: Stainless steel, textured surface.
 - 1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force (1112 N), minimum.
 - b. Dimensions: 1-1/4 inch (32 mm) outside diameter, minimum 0.05 inch (1.3 mm) wall thickness, concealed flange mounting, 1-1/2 inch (38 mm) clearance between wall and inside of grab bar.
 - c. Finish: Satin.
 - d. Length and Configuration: As indicated on drawings.
 - e. Must meet the minimum requirements for grab bars as set forth in ICC A117.1.

2.05 COMMERCIAL SHOWER AND BATH ACCESSORIES

- A. Shower Curtain Rod: Stainless steel tube, 1 inch (25 mm) outside diameter, 0.04 inch (1.0 mm) wall thickness, satin-finished, with 3 inch (75 mm) outside diameter, minimum 0.04 inch (1.0 mm) thick satin-finished stainless steel flanges, for installation with exposed fasteners.
 - 1. Products:
 - a. American Specialties, Inc: www.americanspecialties.com/#sle.
 - b. Substitutions: Section 01 60 00 - Product Requirements.
- B. Shower Curtain:
 - 1. Material: Opaque vinyl, 0.008 inch (0.2 mm) thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
 - 2. Size: 72 by 72 inches (1830 by 1830 mm), hemmed edges.
 - 3. Grommets: Stainless steel; pierced through top hem on 6 inch (150 mm) centers.
 - 4. Color: White.
 - 5. Shower Curtain Hooks: Chrome-plated or stainless steel spring wire designed for snap closure.
- C. Folding Shower Seat: Wall-mounted surface; welded tubular seat frame, structural support members, swing-down legs, hinges, and mechanical fasteners of Type 304 stainless steel, L-shaped, right hand seat.
 - 1. Seat: Phenolic or polymeric composite one-piece seat or seat slats, of color as selected.
 - 2. Size: ADA Standards compliant.
- D. Towel Bar: Stainless steel, 3/4 inch (20 mm) round tubular bar; rectangular brackets, concealed attachment, satin finish.
 - 1. Length: 18 inches (460 mm).
- E. Robe/Towel Hook: Heavy-duty stainless steel, double-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.

2.06 HEALTHCARE ACCESSORIES

- A. Sharps Disposal System
 - 1. Manufacturer: Madison Environmental Resourcing, Inc (MERI); <https://www.meriinc.com/>
800 Uniek Drive, Waunakee, WI 53597.
Contact: Tammy Greiber
1-608-257-7652.
 - a. Sharps Disposal Container.

- 1) Model: #1510 - Wall Mounted 5-Quart Rugged Sharps Box.
 - 2) Outer Box Size: 13-inches high x 12.5-inches wide x 5.5-inches deep to accommodate a 5-quart biohazard insert.
 - (a) Color: Black
 - 3) Lock: 2 Keys included.
 - 4) Mounting Hardware: Not included.
 - 5) Biohazard Insert (included):
 - (a) Size: 12.5-inches high x 11-inches wide x 5.5-inches deep.
 - (b) Material: Rigid plastic.
 - 6) Accessory: Extra Theft-proof lid.
- b. Substitutions: Not permitted.

2.07 UNDER-LAVATORY PIPE AND SUPPLY COVERS

- A. Specified in 22 40 00 - Plumbing Fixtures.

2.08 ELECTRIC HAND/HAIR DRYERS

- A. Electric Hand Dryers (HD-01): Traditional fan-in-case type, with downward fixed nozzle.
1. Basis of Design: Dyson Inc; Dyson Airblade V: www.dyson.com/#sle
 2. Operation: Automatic, sensor-operated on and off.
 3. Mounting: Wall-mounted - surface.
 4. Cover: Epoxy painted steel or die-cast zinc alloy.
 - a. Color: To be selected by Architect from manufacturer standard options..
 - b. Tamper-resistant screw attachment of cover to mounting plate.
 5. Air Velocity: 15,000 linear feet per minute (76 m/s), minimum.
 6. Fan Control: Field adjustable down to approximately half-speed.
 7. Total Wattage: 500 W, maximum; no heater.
 8. Runtime: Field adjustable or automatic, up to 35 seconds.
 9. Supply Voltage: As indicated by manufacturer's installation instructions.
 10. Warranty: 3 years.

2.09 DIAPER CHANGING STATIONS

- A. Diaper Changing Station (CS-01): Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
1. Material: Polyethylene.
 2. Mounting: Surface.
 3. Color: As selected from Manufacturer's standard color options.
 4. Minimum Rated Load: 300 pounds (136.1 kg).
 5. Approximate Size: 35 inches x 20 inches

2.10 UTILITY ROOM ACCESSORIES

- A. Mop and Broom Holder: 0.05 inch (1.3 mm) thick stainless steel, Type 304, hat-shaped channel.
1. Holders: Four spring-loaded rubber cam holders.
 2. Length: Manufacturer's standard length for number of holders.
 3. Products:
 - a. American Specialties, Inc: www.americanspecialties.com/#sle.
 - b. Substitutions: 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.

- C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.
- D. Verify that field measurements are as indicated on drawings.
- E. See Section 06 10 00 Rough Carpentry for installation of blocking, reinforcing plates, and concealed anchors in walls and ceilings.

3.02 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.
 - 1. Refer to accessible mounting height schedule on drawings.
 - 2. Grab Bars: As indicated on drawings.
 - 3. Mirrors: as indicated on the drawings, measured from floor to bottom of mirrored surface.
 - 4. Other Accessories: As indicated on drawings.

3.04 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.

3.05 SCHEDULE

- A. As indicated on drawings.

END OF SECTION

**SECTION 10 28 19
TUB AND SHOWER ENCLOSURES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shower surrounds.

1.02 RELATED REQUIREMENTS

- A. Section 10 28 00 - Toilet, Bath and Laundry Accessories: grab bars, shower seat, shower curtain rod and shower curtain.
- B. Section 22 40 00 - Plumbing Fixtures: faucets and shower head.

1.03 REFERENCE STANDARDS

- A. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- B. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- C. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Shop Drawings: Indicate layout, dimensions, identification of components, and interface with adjacent construction.
- C. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- D. Manufacturer's Installation Instructions: Indicate complete preparation, installation, and cleaning requirements.
- E. Manufacturer's Qualification Statement.
- F. Installer's Qualification Statement.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
 - 1. Provide company, field supervisors, and installers that hold active ANSI accredited certifications in appropriate categories for work specified.
 - a. North American Contractor Certification (NACC) for glazing contractors.
 - b. Equivalent independent third-party ANSI accredited certification.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until installation.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. See Section 01 77 00 - Closeout Procedures, for additional City of Madison warranty requirements.
- C. Correct defective Work within a one year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Cast Polymer Tub and Shower Surrounds:
 - 1. Inpro: www.inprocorp.com/#sle.
 - 2. Kohler Company: www.kohler.com/#sle.
-

3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 SHOWER SURROUNDS

- A. Description: Cast polymer panels self-supporting over structural members; installed in alcove above shower receptor; available as individual panels or as kits.
 - 1. A single one-piece surround integral with shower basin is the preferred option.
- B. ADA Compliance: must meet requirements for transfer shower per ICC A117.1.
- C. Panel Thickness: 0.225 inch (5.7 mm) thick.
- D. Configuration and Dimensions: As indicated on drawings.

2.03 MATERIALS

- A. Cast Polymer Surround Material: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, renewable material filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - 1. Blocking: provide integral blocking to support mounting locations for grab bars and shower seat to meet the minimum requirements for transfer showers per ICC A117.1.
 - 2. Color and Pattern: As selected by from manufacturer's standard line.
- B. Sealant: One-part mildew-resistant silicone sealant, complying with ASTM C920, clear.
- C. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.04 ACCESSORIES

- A. See 10 28 00 - Toilet, Bath and Laundry Accessories, for grab bars and shower seat.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Do not begin installation until supports and adjacent substrates are complete.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean substrates thoroughly prior to installation.
- B. Prepare substrates as recommended by the manufacturer.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings.
- B. Fit and align shower surround level and plumb.

3.04 CLEANING

- A. See Section 01 74 19 - Construction Waste Management and Disposal, for additional requirements.

3.05 CLOSEOUT ACTIVITIES

- A. See Section 01 77 00 - Closeout Procedures and Section 01 33 23 - Submittals, for closeout submittal requirements for the City of Madison.

3.06 PROTECTION

- A. Protect installed products until Date of Substantial Completion.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

**SECTION 10 43 00
EMERGENCY AID SPECIALTIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Automated external defibrillators (AEDs).
- B. First aid cabinets.
- C. Accessories.

1.02 RELATED REQUIREMENTS

1.03 DEFINITIONS

- A. Automated External Defibrillator (AED): A Food and Drug Administration (FDA)-approved portable device, which automatically analyzes the heart rhythm and recognizes the presence of ventricular fibrillation and/or tachycardia. If defibrillation is warranted, the AED automatically charges and prompts (visual and/or audio) the operator to deliver an electrical shock.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide AED operational features, color and finish, anchorage details, and installation instructions.
- C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include test schedules and recertification requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Automated External Defibrillators (AEDs):
 - 1. ZOLL Medical Corporation; www.zoll.com
 - a. Model: **AED-Plus**
 - 2. Substitutions: Not permitted.
- B. Emergency Aid Cabinets and Accessories:
 - 1. ZOLL Medical Corporation; www.zoll.com
 - 2. Substitutions: Not permitted.

2.02 AUTOMATED EXTERNAL DEFIBRILLATORS (AEDS)

- A. Automated External Defibrillators (AEDs) - General: FDA approval required.
 - 1. Provide automated external defibrillators (AEDs) as indicated.

2.03 EMERGENCY AID CABINETS

- A. Type: Automated external defibrillator (AED).
- B. 7 inch Standard Wall Cabinet with battery alarm
 - 1. Product number: 8000-0817
- C. Cabinet Construction: Non-fire-rated.
- D. Cabinet Configuration: Surface mounted type.
 - 1. 7 inch Standard Wall Cabinet with alarm
 - 2. Exterior nominal dimensions of 17.5 inch (44.45 cm) wide by 17.5 inch (44.45 cm) high by 7 inch (17.78 cm) deep.

- 3. Trimless type.
- 4. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim.
- E. Door Glazing: Acrylic plastic, clear, 1/8 inch (3 mm) thick, flat shape and set in resilient channel glazing gasket.
- F. Cabinet Mounting Hardware: Appropriate to cabinet, with predrilled holes for placement of anchors.
- G. Fabrication: Weld, fill, and grind components smooth.
- H. Finish of Cabinet Exterior Trim and Door: Powder coat, white color.
- I. Finish of Door Pull or Handle: as selected from manufacturers standard options.
- J. Finish of Cabinet Interior: White powder coat.

2.04 ACCESSORIES

- A. Theft Alarm: Battery operated audible alarm, 10 second delay for disarming, activated by opening cabinet door. Alarm deactivated when door is closed.
 - 1. Type 123 Lithium Batteries: Product Number 8000-0807-01
- B. Compact Low Profile Public Safety Cover (AED-Plus)
 - 1. Product Number: 8000-0803-01
- C. Cabinet Door Signage: 'Automated External Defibrillator" decal, or vinyl self-adhering, pre-spaced red lettering and identifying graphic in accordance with authorities having jurisdiction (AHJ).
- D. AED Wall Sign Kit: 1 each per cabinet; Flat and Tent (3D) style.
 - 1. Zoll Product # 8000-0825

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and within accessible reach ranges per ICC A117.1.
- C. Secure rigidly in place.
- D. Place AEDs in cabinets.
- E. Wall Signs:
 - 1. Location: Coordinate location with Owner.
 - 2. Apply on walls after field painting is completed and has been accepted.
- F. Cabinet Lettering:
 - 1. Location: Face of door framing.
 - 2. Apply lettering on factory-finished cabinets either at the factory or just prior to Substantial Completion.

3.03 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust cabinet doors to operate smoothly without binding. Verify that alarms and integral locking devices operate properly.
- C. On completion of cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

- D. Touch up marred finishes. Replace cabinets that cannot be restored to factory-finished appearance. Use materials and procedures recommended by cabinet manufacturer.

3.04 CLOSEOUT ACTIVITIES

- A. See Section 01 77 00-Closeout Procedures for closeout submittals.
- B. Demonstrate proper operation of AED to Owner's designated representative.

END OF SECTION

**SECTION 10 44 00
FIRE PROTECTION SPECIALTIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Self-service reloadable fire extinguishers.
- C. Fire blankets.
- D. Fire extinguisher cabinets.
- E. Accessories.

1.02 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.
- B. FM (AG) - FM Approval Guide; Current Edition.
- C. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.
- D. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide extinguisher operational features.
- C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.04 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Extinguishers:
 - 1. Activar Construction Products Group, Inc. - JL Industries; Cosmic Extinguisher - Multipurpose Chemical: www.activarcpg.com/#sle.
 - 2. Ansul, a Tyco Business: www.ansul.com/#sle.
 - 3. Kidde, a unit of United Technologies Corp: www.kidde.com/#sle.
 - 4. Nystrom, Inc: www.nystrom.com/#sle.
 - 5. Oval Brand Fire Products; Oval Dry Chemical Fire Extinguisher - Multipurpose ABC: www.ovalfireproducts.com/#sle.
 - 6. Potter-Roemer: www.potterroemer.com/#sle.
 - 7. Pyro-Chem, a Tyco Business: www.pyrochem.com/#sle.
 - 8. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fire Extinguisher Cabinets and Accessories:
 - 1. Activar Construction Products Group, Inc. - JL Industries; Ambassador Series: www.activarcpg.com/#sle.
 - 2. Kidde, a unit of United Technologies Corp: www.kidde.com/#sle.
 - 3. Larsen's Manufacturing Co: www.larsensmfg.com/#sle.
 - 4. Nystrom, Inc: www.nystrom.com/#sle.

5. Oval Brand Fire Products; Cabinets for Low Profile Extinguishers:
www.ovalfireproducts.com/#sle.
 6. Potter-Roemer: www.potterroemer.com/#sle.
 7. The Williams Brothers Corporation of America; Classic Economy Series:
www.wbdoors.com/#sle.
 8. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Fire Hose and Hydrant Cabinets and Accessories:
1. The Williams Brothers Corporation of America; Hose & Hydrant Storage Series:
www.wbdoors.com/#sle.
 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: 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.
- B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
1. Class: A:B:C type.
 2. Size and classification as scheduled.
 3. Temperature range: Minus 40 degrees F (Minus 40 degrees C) to 120 degrees F (49 degrees C).

2.03 FIRE EXTINGUISHER CABINETS

- A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.
- B. Cabinet Construction: Non-fire rated.
1. Formed primed steel sheet; 0.036 inch (0.9 mm) thick base metal.
- C. Fire Rated Cabinet Construction: One-hour fire rated.
1. Steel; double wall or outer and inner boxes with 5/8 inch (15.9 mm) thick fire barrier material.
- D. Cabinet Configuration: Semi-recessed type.
1. Size to accommodate accessories.
 2. Trimless type.
 3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.
- E. Door: 0.036 inch (0.9 mm) metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinges.
- F. Door Glazing: Acrylic plastic, clear, 1/8 inch (3 mm) thick, flat shape and set in resilient channel glazing gasket.
- G. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- H. Fabrication: Weld, fill, and grind components smooth.
- I. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.
- J. Finish of Cabinet Interior: White colored enamel.

2.04 ACCESSORIES

- A. Fire Blanket: Fire retardant treated wool; red, 62 by 84 inch (1575 by 2135 mm) size.
- B. Extinguisher Brackets: Formed steel, chrome-plated.
- C. Extinguisher Theft Alarm: Battery operated alarm, 10 second delay for disarming, activated by opening cabinet door.
- D. Lettering: "FIRE EXTINGUISHER" decal, or vinyl self-adhering, prespaced black lettering in accordance with authorities having jurisdiction (AHJ).

- E. Floor Signs:

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure rigidly in place.
- C. Place extinguishers in cabinets.

3.03 MAINTENANCE

- A. See Section 01 77 00-Closeout Procedures for additional requirements relating to maintenance service.

3.04 MAINTENANCE - SELF-SERVICE FIRE EXTINGUISHERS

- A. Monthly Inspections: Inspect self-service fire extinguishers on monthly basis in accordance with manufacturer's instructions, and requirements of the authorities having jurisdiction (AHJ).
- B. Annual Inspections: Inspect self-service fire extinguishers on annual basis in accordance with manufacturer's instructions, and requirements of the authorities having jurisdiction (AHJ).
- C. Inspection Certification Tag: Provide new tag indicating acceptable condition of fire extinguisher, date of inspection, and name of self-service inspector for each inspection.

END OF SECTION

**SECTION 10 51 29
PHENOLIC LOCKERS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Phenolic lockers.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry Wood blocking and nailers.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Manufacturer's published data on locker construction, sizes and accessories.
- C. Shop Drawings: Indicate locker plan layout, numbering plan.
- D. Manufacturer's Installation Instructions: Indicate component installation assembly.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Phenolic Lockers:
 - 1. ASI Storage Solutions: www.asi-storage.com/#sle.
 - 2. Columbia Lockers, a division of PSiSC; Phenolic Lockers: www.psisc.com/#sle.
 - 3. Grid; Club Lockers - Phenolic: www.builtbygrid.com/#sle.
 - 4. List Industries, Inc: www.listindustries.com/#sle.
 - 5. Summit Lockers, Inc: www.summitlockers.com/#sle.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 LOCKER APPLICATIONS

- A. Lockers: Phenolic lockers, recessed mounted.
 - 1. Accessibility: Comply with ICC A117.1 and ADA Standards.
 - 2. Width: 15 inches (381 mm).
 - 3. Depth: 12 inches (305 mm).
 - 4. Height: 72 inches (1830 mm).
 - 5. Locker Configuration: Two tier.
 - 6. Fittings: Size and configuration as indicated on drawings.
 - 7. Locking: Built-in combination locks.
 - 8. Provide sloped top.

2.03 PHENOLIC LOCKERS

- A. Lockers: Factory assembled, made of phenolic core panels with mortise and tenon joints and stainless steel mechanical joint fasteners; fully finished inside and out; each locker capable of standing alone.
 - 1. Doors: Full overlay, covering full width and height of locker body; square edges.
 - 2. Panel Core Exposed at Edges: Machine polished, without chips or tool marks; square edge unless otherwise indicated.
 - 3. Where locker ends or sides are exposed, finish the same as fronts or provide extra panels to match fronts.

4. Door Color: As selected by Architect; allow for 2 different colors.
 5. Body Color: Manufacturer's standard white or light color.
 6. Fasteners for Accessories and Locking Mechanisms: Tamperproof type.
- B. Component Thicknesses:
1. Doors: 1/2 inch (13 mm) minimum thickness.
 2. Locker Body: One of the following combinations:
 - a. Tops, bottoms, and shelves 3/8 inch (10 mm); sides and backs 5/16 inch (8 mm); minimum.
 - b. Tops, bottoms, and shelves 1/2 inch (13 mm); sides 3/8 inch (10 mm); backs 1/4 inch (6 mm); minimum.
 3. Sloped Tops: 1/2 inch (13 mm) minimum thickness.
 4. Toe Kick Plates: 1/2 inch (13 mm) minimum thickness.
- C. Phenolic Core Panels: Nonporous phenolic resin and paper core formed under high pressure, with natural colored finished edges, integral melamine surface, matte finish, and uniform surface appearance; glued laminated panels not acceptable.
1. Surface Burning Characteristics: Flame spread index of 75 or less, and smoke developed index of 450 or less; when tested in accordance with ASTM E84.
- D. Number Plates: Manufacturer's standard, minimum 4-digit, permanently attached with adhesive; may be field installed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared bases are in correct position and configuration.
- B. Verify bases and embedded anchors are properly sized.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Place and secure on prepared base.
- C. Install lockers plumb and square.
- D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds (445 N).
- E. Bolt adjoining locker units together to provide rigid installation.
- F. Install end panels, filler panels, and sloped tops.
- G. Install accessories.
- H. Replace components that do not operate smoothly.

3.03 CLEANING

- A. Clean locker interiors and exterior surfaces.

END OF SECTION

**SECTION 10 55 00
POSTAL SPECIALTIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Mail and package delivery box - Exterior for USPS delivery only.
- B. NOTE: if a box is desired for non-USPS deliveries, then an additional box will need to be purchased and installed and clearly labeled for non-USPS deliveries.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete pad at mailbox location.

1.03 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. 39 CFR 111 - U.S. Postal Service Standard 4C; Current Edition.
- C. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide manufacturer's specifications and descriptive literature, installation instructions, maintenance information, and current USPS approval documentation.
- C. Samples: Submit two sets of manufacturer's available colors.

1.05 WARRANTY

- A. See Section 01 78 00 - Closeout Procedures for additional warranty requirements.
- B. Provide manufacturer's Limited Lifetime Warranty against defects in materials or workmanship.

PART 2 PRODUCTS

2.01 MAIL AND PACKAGE DELIVERY BOXES

- A. Manufacturers:
 - 1. MailCase Locking Mailboxes; <https://www.mailcase.com/>; 1-800-238-5417
 - 2. Substitutions: Not permitted.
- B. Outdoor Mail and Parcel Delivery Box: Pedestal-mounted, mail / parcel receptacle with weather-resistant cabinet for outdoor installation. Approved for United States Postal Service (USPS) delivery by the Postmaster General.
 - 1. Model: 9207-XX
 - 2. Materials: Zinc Alloy Steel, welded construction with stainless steel hardware.
 - a. Delivery tray, top, sides and rear panels are 14 gauge steel
 - b. Front doors and bottom are 12 guage steel.
 - 3. Finish: UV protected powdercoat in color selected by Architect from manufacturer's standard colors (-XX) as listed below:
 - a. -BL Black
 - b. -RB Rich Bronze
 - c. -SG Storm Gray
 - d. -WT White
 - 4. Front loading access door for keyless USPS delivery of mail and packages.
 - 5. Outgoing mail clip on front access door and magnetic outgoingmail flag.
 - 6. Front retrieval access door with anti-theft protection.
 - 7. Tubular lock for customer retrieval. Provide 6 keys per box.
 - 8. Configurations: See drawings for overall dimensions and layouts.

9. Parcel Sizes: Largest rigid parcel sizes are 3"x9"x11" or 4.5"x5"x7". Soft packages are only restricted by compression ability and room remaining inside the box.
10. Limited Lifetime Warranty and Attempted Breakin Guarantee.

2.02 COMPONENTS

- A. Pedestal: Standard 4x4 inch square steel post with UV protected powder coat finish to match MailCase. Designed to meet USPS and height requirements of ADA Standards.
 1. Surface Mounted Post (Preferred): 28-inches long with 1/4" steel flanges on both ends and hardware to mount mailbox to post and mount post to concrete surface.
 2. In-Ground Post Mounted (option): 47-inches long with 1/4" steel flange on one end. Intended to be buried in hole filled with concrete. Includes mounting hardware to mount mailbox to post.
- B. Identification - USPS approved address label for mailbox:
 1. Coordinate with local US Post Office on preferred location of address identification (i.e. both sides or on front of box on customer retrieval door) prior to ordering.
 2. Material:
 - a. Option 1 (preferred): Fabricated Adhesive Vinyl Address numbers in a contrasting color. Letters to be minimum 2-inches tall. Vinyl to be UV and weather resistant and light reflective.
 - 1) Available from MailCase as a decal to be field installed.
 - b. Option 2: Silver adhesive decals, 3/4 inch (19 mm) high black characters centered on 1-1/2 inch (38 mm) high by 1-3/4 inch (44 mm) long decal.
 - c. Available from multiple sources.
 3. Multiple Boxes: If an additional MailCase is ordered and installed for non-USPS parcel delivery, then a vinyl sign should be ordered that reads "For USPS Deliveries Only" to be installed on box with the address.
- C. Spreader Bar for multiple boxes:
 1. Two-Place Spreader Bar is 28-inches long and made from 12-gauge, powder coated zinc-alloy steel. Intended to be used with a single MailCase mounting post and two (2) MailCase boxes.
 - a. Requires post to be installed in 90-degree rotation than from a single box installation.
 - b. Color: to match post and mailbox.
 2. Three-Place Spreader Bar is 38-inches long and made from 12-gauge, powder coated zinc-alloy steel. Intended to be used with a single MailCase mounting post and three (3) MailCase boxes.
 - a. Requires post to be installed in 90-degree rotation than from a single box installation.
 - b. Color: to match post and mailbox.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Surface mounted post: Verify that concrete base is ready to receive pedestal-mounted units. Location of concrete base should insure that finished height of mailbox will meet USPS requirements and ADA accessibility.
- B. In-Ground mounted post: Verify that hole has been dug deep enough for finished box height to meet USPS requirements and ADA accessibility.
- C. Do not begin installation until unacceptable conditions are corrected.

3.02 INSTALLATION

- A. Install postal specialties in accordance with approved shop drawings, manufacturer's instructions, and USPS requirements.
- B. Adjust and lubricate door hardware to operate properly.
- C. Install mailbox identification items.

END OF SECTION

SECTION 10 56 17
WALL MOUNTED STANDARDS AND SHELVING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Steel shelf standards, brackets, and accessories.
- B. Shelves.
- C. See drawings for locations and configurations.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood blocking in walls for attachment of standards.
- B. Section 06 20 00 - Finish Carpentry: Wood shelves.
- C. Section 09 21 16 - Gypsum Board Assemblies: Blocking in metal stud walls for attachment of standards.

1.03 REFERENCE STANDARDS

- A. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements for additional provisions.
 - 2. Extra Brackets: Ten of each size of standard straight bracket.

1.05 QUALITY ASSURANCE

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

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products under cover and elevated above grade.
- B. Store products in manufacturer's unopened packaging until ready for installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Steel Shelf Standards and Brackets:
 - 1. Knappe & Vogt Manufacturing Company; 87™/187™ Series: www.knappeandvogt.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 COMPONENTS

- A. Steel Shelf Standards, Brackets, and Accessories:
 - 1. Heavy-Duty Shelf Standards and Brackets: Double-slotted channel standards for brackets adjustable in 1 inch (25 mm) increments along entire length of standard, drilled and countersunk for screws.
 - a. Product: KV 82/182.
 - b. Load Capacity: Recommended by manufacturer for loading of 300 to 450 pounds (135 to 200 kg) per pair of standards.
 - c. Lengths: As indicated on drawings.
 - d. Color: To be selected by Architect from manufacturer's full line.
 - e. Brackets: Double tab type, locking into slots; size to suit shelves; same finish as standards.
 - f. Bracket Quantity: Provide one bracket for each 12 inches (305 mm) of standard length.
 - 2. Shelf Standard Accessories:

- a. Where shelves are indicated to be fastened to brackets provide brackets with flanges for screwing into end of shelf, steel shelf rests, or flanged brackets; fasten with screws.
 - b. Provide other accessories as indicated.
- B. Shelving:
 - 1. Laminate Faced Shelves: Particleboard or medium density fiberboard covered with high pressure decorative laminate on both sides.
 - a. Edge Finish: Matching laminate, all four edges.
 - b. Substrate Thickness: 3/4 inch (19 mm), nominal.
 - c. Length: As indicated on drawings.
 - d. Laminate: NEMA LD 3 Type HGL.
 - e. Laminate Color and Pattern: As indicated on drawings.
- C. Fasteners: Screws as recommended by manufacturer for intended application or as otherwise required by project conditions. Finish of exposed to view fasteners to match finish of standards and other components.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Mount standards or brackets to solid backing capable of supporting intended loads.
- C. Install brackets, shelving, and accessories.

3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

**SECTION 10 71 13.43
FIXED SUN SCREENS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Modular, shop fabricated, extruded aluminum sun screens to be mounted on structure provided by other sections.
- B. The entire scope of work listed here is included in General Contractor's scope of work.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Mounting substrates.
- B. Section 05 12 00 - Structural Steel Framing: Mounting substrates.
- C. Section 07 42 13 - Metal Wall Panels: Mounting substrates.

1.03 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2023.
- C. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- D. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2023.
- E. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- H. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2022.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
 - B. Shop Drawings: Prior to commencement of fabrication, submit detailed shop drawings, showing all profiles, sections of all components, finishes, fastening details, and manufacturer's technical and descriptive data. Include field dimensions of openings and elevations on shop drawings.
 - C. Design Data: Submit comprehensive structural analysis of design for the specified loads. Stamp and sign calculations by professional engineer.
 - D. Samples: 10 inches (254 mm) by 24 inches (609.6 mm) minimum illustrating design, workmanship and finish color.
 - 1. Submit color chips for approval.
 - E. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - F. Designer's Qualification Statement.
 - G. Manufacturer's Qualification Statement.
 - H. Installer's Qualification Statement.
 - I. Specimen Warranty: Furnish a copy of manufacturer's standard warranty.
-

1.05 QUALITY ASSURANCE

- A. Single subcontract responsibility: Subcontract the work to a single firm that has experience in the design and manufacturing of work similar to that shown and required. For quality and delivery control, sun shades must be purchased from a single source. Sub-contracting of sunshade assembly is not acceptable.
- B. Designer Qualifications: Perform structural design under direct supervision of a Professional Engineer experienced in design of this type of work licensed in the State in which the Project is located.
- C. Performance: Design sun shades to accommodate local requirements for snow and wind loading. Provide engineering calculations to support design. Calculations to be by a registered engineer licensed in the state the project is located. Analysis to include all components of sunshade including but not limited to deflection of panels and support components. Deflection to be limited to L/120, 3/4", or as required by code.
- D. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with no less than five years of documented experience.
- E. Installer Qualifications: Company specializing in performing the work of this section.
 - 1. Approved by manufacturer.

1.06 COORDINATION

- A. Coordinate installation of anchorages for sun shade panels. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.
- B. Coordinate installation of sun shades with adjacent construction to ensure that wall assemblies, flashings, trim, and joint sealants, are protected against damage from the effects of weather, age, corrosion, and other causes of deterioration.

1.07 DELEGATED DESIGN REQUIREMENTS

- 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. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit 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.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. At the time of delivery all materials shall be visually inspected for damage. Any damaged boxes, crates, panel sections, etc. shall be noted on the receiving ticket and immediately reported to the shipping company and the material manufacturer
- B. Deliver materials to project site ready for erection.
- C. Package using methods that prevent damage during shipping and storage on site.
- D. Material shall be stored flat.
- E. Material may be stored either indoors or outdoors.
 - 1. If stored outdoors the material must be raised sufficiently off the ground to prevent it being flooded.
 - 2. If stored outdoors the material must be covered with a weather proof flame resistant sheeting or tarpaulin.

1.09 WARRANTY

- A. See Section 01 77 00-Closeout Procedures, for additional warranty requirements.
- B. Sun Screens: Correct defective work within a one year period after Date of Substantial Completion.
- C. Finish Warranty: Provide manufacturer's five year warranty on factory finish against cracking, peeling, and blistering.
 - 1. If a Two Coat Fluorocarbon Coating is applied, then Manufacturer to furnish an extended 10 year warranty. AAMA 2605 certification. This limited warranty shall begin on the date of material shipment.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Fixed Aluminum Sun Screens:
 - 1. Basis of Design: ReVamp Panels, LLC. www.revamppanels.com.
 - 2. Alternate: BOK Modern, Inc.; www.bokmodern.com
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 SUN SCREENS

- A. Aluminum Sun Screens: Shop fabricated, shop finished, extruded aluminum outriggers, louvers, and fascia, free of defects impairing strength, durability or appearance.
 - 1. Basis of Design: ReVamp Panel, LLC
 - a. Pattern: Nest (RP008.2)
 - b. Alternate Pattern: Complex Nest (RP008)
 - 2. Configuration: As indicated on drawings.
 - 3. Louver Type: Perforated Panel.
 - 4. Sun Screen Angle: 90 degrees from horizontal.
 - 5. Outrigger Shape: Straight.
 - 6. Design Criteria: Design and fabricate to resist the following loads without failure, damage, or permanent deflection:
 - a. Wind: 115 MPH
 - b. Snow: 50 psf
 - c. Thermal Movement: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of connections and other detrimental effects. Base calculation on surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.
 - 1) Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces
 - 7. Structural movement: Accommodate movement of supporting structural framing and without causing bowing, buckling, delamination, oil canning, excessive stress on fasteners, or any other detrimental effects.
 - 8. Sizes: As indicated on drawings.
 - 9. Exposed Aluminum Finish: Powder-coated, 3/16" aluminum.
 - a. Alternate Finish: PVDP, 3/16" aluminum
 - 10. Provide a complete system ready for erection at project site.

2.03 MATERIALS

- A. Aluminum Extrusions: ASTM B209/B209M or ASTM B221 (ASTM B221M).
 - 1. ReVamp Sun Shade Panels: Alloy 5052-H32
 - 2. 3/16" thick formed with 1½-inch return flange on all four sides with laser-cut decorative pattern.
- B. Aluminum Coated Steel Sheet: ASTM A792/A792M.
- C. Concealed Structural Supports: Aluminum, or steel coated for corrosion resistance and dissimilar metal isolation.
 - 1. Revamp Sun Shade Brackets: A36 Steel, Hot Rolled, Pickled and Oiled, 1/2 inch thick.

- D. Fasteners: ASTM F593 stainless steel.
 - 1. Fasteners to structural steel shall be provided with a threaded insert.
 - 2. Self-tapping fasteners not permitted.
- E. Sunshade Separation: Self-adhering neoprene strips; location and dimensions as indicated on the drawings.

2.04 FINISHES

- A. General: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated. Apply finishes in factory. Protect finishes on exposed surfaces prior to shipment. Remove scratches and blemishes from exposed surfaces that will be visible after completing finishing process. Provide color as indicated or, if not otherwise indicated, as selected by architect from Manufacturer's full range.
- B. Sun Shades shall be finished with Cardinal Powder Coat: www.cardinalpaint.com in accordance with the paint manufacturer's directions.
- C. Superior Performing Organic Coatings: AAMA 2605 multiple coat, thermally cured polyvinylidene fluoride system.
 - 1. Two Coat Fluorocarbon Coating
 - a. Sun Shades to be finished with full strength 70% PVDF 2 coat Fluoropolymer system. With a minimum 1.0 mil (0.025mm) primer coat and 1.0 mil (0.025mm) top coat thickness.
 - b. All aluminum shall be thoroughly cleaned, etched and given a chromated conversion pre-treatment before application. The coating shall consist of a primer and a pigmented PVDF topcoat. It shall receive a bake cycle of 17 minutes at 450°F. All finishing procedures shall be one continuous operation in the plant of the manufacturer.
 - 2. Manufacturer to furnish an extended 10 year warranty. AAMA 2605 certification. This limited warranty shall begin on the date of material shipment.
- D. Finish Color: As indicated on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and site area for conditions that might prevent satisfactory installation.
- B. Verify that dimensions of supporting structure are within plus/minus 1/8 inch (3.175 mm) of dimensions indicated on shop drawings.
- C. Verify that all adjacent painting, roofing, masonry work, and other work that might damage sun screen finish has been completed prior to installation of sun screens.
- D. Do not install until after all adjacent painting, roofing and masonry have been completed.
- E. Do not proceed with installation until all conditions are satisfactory.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's installation instructions.
- B. Set units level, plumb, with uniform joints, and aligned with building elements.
- C. Cut and trim component parts during erection only with the approval of the manufacturer or fabricator, and in accordance with manufacturer recommendations. Restore finish completely. Remove and replace members where cutting and trimming has impaired the strength or appearance of the assembly.
- D. Do not erect warped, bowed, deformed or otherwise damaged or defaced members. Remove and replace any members damaged in the erection process as directed.
- E. Separate dissimilar metals using concealed bituminous paint or non-absorbent gasket.
- F. Anchor units to structure as indicated on drawings.

G. Do not cut or trim aluminum members without approval of manufacturer; do not install damaged members.

1. Remove and replace members where cutting and trimming has impaired the strength of appearance of the assembly.

H. Touch-up damaged finish coating using material provided by manufacturer to match original coating.

3.03 TOLERANCES

A. Erection Tolerances

1. Maximum variation from plane or location shown on the approved shop drawings: 1/8 inch per 12 feet of length, but not exceeding 1/2 inch in any total building length or portion thereof (non-cumulative)
2. Maximum offset from true alignment between two members abutting end to end, edge-to-edge in line or separated by less than 3 inches: 1/16 inch (shop or field joints). This limiting condition shall prevail under both load and no-load conditions.

3.04 CLEANING

A. Clean exterior surfaces units of dust and debris; follow manufacturer's cleaning instructions for the finish used.

3.05 PROTECTION

A. Protect units after installation to prevent damage due to other work until Date of Substantial Completion.

END OF SECTION

SECTION 11 30 13 RESIDENTIAL APPLIANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Kitchen appliances.

1.02 RELATED REQUIREMENTS

- A. Section 12 32 00 - Manufactured Casework: Coordinate appliance clear opening sizes.
- B. Section 22 10 05 - Plumbing Piping: Plumbing connections for appliances.
- C. Section 26 05 83 - Wiring Connections: Electrical connections for appliances.

1.03 REFERENCE STANDARDS

- A. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Manufacturer's data indicating dimensions, capacity, and operating features of each piece of residential equipment specified.
- C. Copies of Warranties: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Electric Appliances: Listed and labeled by UL (DIR) and complying with NEMA Standards (National Electrical Manufacturers Association).
- C. Gas Appliances: Bearing design certification seal of American Gas Association (AGA).

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five (5) year manufacturer warranty on refrigeration system of refrigerators.
- C. Provide ten (10) year manufacturer warranty on magnetron tube of microwave ovens.

PART 2 PRODUCTS

2.01 KITCHEN APPLIANCES

- A. Provide Equipment Eligible for Energy Star Rating: Energy Star Rated.
- B. Provide appliances from the same manufacturer, preferred.
- C. Refrigerator: Free-standing, side-by-side, and frost-free.
 - 1. Capacity: Total minimum storage of 18 cubic ft (0.51 cu m); minimum 15 percent freezer capacity.
 - 2. Energy Usage: Minimum 20 percent more energy efficient than energy efficiency standards set by U.S. Department of Energy (DOE).
 - 3. Features: Include glass shelves, automatic icemaker, light in freezer compartment, and in-door water and ice dispenser.
 - 4. Exterior Finish: Porcelain enameled steel, color as indicated.
 - 5. Manufacturers:
 - a. Frigidaire Home Products: www.frigidaire.com/#sle.
 - b. GE Appliances: www.geappliances.com/#sle.
 - c. Whirlpool Corp: www.whirlpool.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

- D. Microwave: Undercounter.
 - 1. Capacity: 0.7 cubic ft (0.019 cu m), minimum.
 - 2. Power: 700 watts.
 - 3. Features: Include turntable, cooktop light, night light, 2-speed exhaust fan, built-in trim kit, and undercabinet mounting kit.
 - 4. Exterior Finish: Selected from Manufacturer's standard finishes.
 - 5. Manufacturers:
 - a. GE Appliances: www.geappliances.com/#sle.
 - b. Whirlpool Corp: www.whirlpool.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify utility rough-ins are provided and correctly located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Anchor built-in equipment in place.

3.03 ADJUSTING

- A. Adjust equipment to provide efficient operation.

3.04 CLEANING

- A. Remove packing materials from equipment and properly discard.
- B. Wash and clean equipment.

END OF SECTION

**SECTION 11 51 01
BOOK DEPOSITORY****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Through-wall book depository (exterior wall).
- B. Through-wall book depository (circulation desk)

1.02 RELATED SECTIONS

- A. 06 10 00 – Rough Carpentry
- B. 06 41 00 - Architectural Wood Casework; circulation desk
- C. 07 92 00 – Joint Sealants

1.03 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- D. Verification Samples: For each finish product specified, two samples, representing actual product and finish.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 5 years experience manufacturing similar products.
- B. Installer Qualifications: Minimum 2 years experience installing similar products.

1.05 PRE-INSTALLATION MEETINGS

- A. Convene minimum two weeks prior to starting work of this section.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- B. Handling: Handle materials to avoid damage.

1.07 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.08 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Kingsley Library Equipment, www.kingsley.com
- B. Requests for substitutions will be considered in accordance with the provisions of Section 01 60 00 - Product Requirements.

2.02 MATERIALS

A. EXTERIOR Book Depository: Non-powered through wall unit.

1. Basis of Design: EASE SingleDrop ThruWall #10-8100
 - a. Materials:
 - 1) Exterior: Heavy-duty stainless steel faceplate, depository door flap, and built-in weather hood.
 - 2) Interior: Aircraft grade aluminum body including 13-inch four-sided chute housing. Aluminum backtrim piece.
 - b. Assembly: Pre-assembled, one piece unit, easy to install. The internal slide is a separate piece that must be hooked in separately once the depository is installed. This allows the internal slide to be adjusted in height if needed.
 - c. Weather Resistance: Equipped with MagnaClose technology that automatically closes the depository door after materials have passed through. Depository door is gravity and weight balanced to prevent the entry of rain or snow and stays closed in most winds.
 - d. Air Draft Prevention: Internal AirBloc System (neoprene rubber panels) to eliminate drafts when depository door is open.
 - e. Locking: Depository door locks from the inside with rotating locking rod mechanism. Operated by an easy to use knob.
 - f. Theft/Vandal Deterrence: The upward angle of the entry chute, length of the slide chute, and the AirBloc system prevent reaching inside through the depository door and block theft of materials with a claw apparatus.
 - g. Labeling: Vinyl decal, silkscreen, and routing available. See website for complete list of standard wording options.
 - h. Measurements:
 - 1) Overall: 22-1/2 inches W x 16-1/2 inches D x 20-1/2 inches H. [571.5 mm W x 419.1 mm D x 520.7 mm H]
 - 2) Depository opening: 17-3/4 inches W x 2-7/8 inches H. [450.8 mm W x 73 mm H]
 - 3) Rough Opening (R.O.): 20-3/16 inches W x 18-5/16 inches H. [512.76 mm W x 465.1 mm H]
 - 4) Bottom of R.O. is 39-1/2 inches [1003.3 mm] above exterior ground.
 - (a) Verify R.O. with manufacturer before installation.
 - 5) Maximum wall thickness is 13 inches, unless extension kit is purchased.
 - 6) Weight: 17 lbs [7.7 kg].
 - i. Hardware: mounting screws are provided by the manufacturer. Unit is attached from inside through predrilled holes on sides of the aluminum housing.

B. INTERIOR Book Depository: Non-powered through wall unit.

1. Basis of Design: HALLPASS Interior ThruWall #43-8105
 - a. Materials:
 - 1) Exterior: Heavy-duty stainless steel faceplate, depository door flap.
 - 2) Interior: Aircraft grade aluminum body including 8-inch four-sided chute housing. Aluminum backtrim piece.
 - b. Assembly: Pre-assembled, one piece unit, easy to install.
 - c. Locking: Depository door locks from the inside with thumb screws.
 - d. Theft/Vandal Deterrence: The upward angle of the entry chute, length of the slide chute prevent reaching inside through the depository door and block theft of materials with a claw apparatus.
 - e. Labeling: Vinyl decal. See website for complete list of standard wording options.
 - f. Measurements:
 - 1) Overall: 22-7/8 inches W x 8-13/16 inches D x 11 inches H. [581.02 mm W x 223.87 mm D x 279.4 mm H]
 - 2) Depository opening: 19-5/8 inches W x 3-1/2 inches H. [498.47 mm W x 88.9 mm H]

- 3) Rough Opening (R.O.): 20.25 inches W x 8.13 inches H. [514.35 mm W x 206.5 mm H]
- 4) Maximum Bottom of R.O. is 39-1/2 inches [1003.3 mm] above finished floor.
 - (a) Verify R.O. with manufacturer before installation.
 - (b) See details on drawings for preferred height within the circulation desk.
- 5) Maximum wall thickness is 8 inches.
- 6) Weight: 6-1/2 lbs [2.95 kg].
- g. Hardware: mounting screws are provided by the manufacturer. Unit is attached from inside through predrilled holes on sides of the aluminum housing.

2.03 ACCESSORIES

- A. Silicone based caulking material compatible with building envelope material and thru-wall unit. Caulk to be applied to inside face of faceplate on all four sides prior to installing unit through rough opening.
- B. Gasket material can be used in lieu of silicone caulking. Should be self-adhering and compatible with building envelope material.
- C. Wood shims ¼ inch for leveling the unit at installation.
- D. Optional Accessories:
 1. Verify with Owner if optional accessories are desired.
 2. Thick Wall Extension Kit - #19-0001 (for walls 13-24 inches thick).
 3. Braille Tags
 - a. #99-8100 Reads: BOOK DROP
 - b. #99-8105 Reads: VIDEO DROP
 4. Custom Wording – contact manufacturer for quote.
 5. Transport Carts:
 - a. EAVE ThruWall is compatible with any Kingsley receiving cart, contingent on height of installation. Also compatible with most conveyor systems.
 - b. HALLPASS ThruWall is compatible with any Kingsley receiving cart except for the divided DualDrop carts. Compatible with 30-9044 when installed in a circulation desk.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect and General Contractor of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. To ensure ADA compliance and proper clearance for a Kingsley ballot cart, the exterior thru-wall unit must be installed so that the measurement from the exterior ground to the bottom of the depository is 48 inches.
- B. To ensure ADA compliance and proper clearance for a Kingsley receiving cart, the interior thru-wall unit must be installed so that the measurement from the finished floor to the bottom of the depository is 40 inches.
- C. Be aware of the interior and exterior grades of your building. If the interior and exterior grades are different, then it will affect the cart clearance inside the building.
- D. Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction. Test for proper operation and adjust until satisfactory results are obtained.

3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

**SECTION 11 52 13
PROJECTION SCREENS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Front projection screen assemblies.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood blocking in walls and ceilings.
- B. Section 06 20 00 - Finish Carpentry: Site constructed wood frames for rear projection screens.
- C. Section 09 21 16 - Gypsum Board Assemblies: Suspended gypsum board ceilings for recessed screens, and openings in gypsum board partitions for fixed and rear projection screens.
- D. Section 09 51 00 - Acoustical Ceilings: Suspended panel ceilings for recessed screens.
- E. Section 09 91 23 - Interior Painting: Field painting.
- F. Section 26 05 83 - Wiring Connections: Electrical supply, conduit, and wiring for electric motor operated projection screens.
- G. Section 24 41 23 - Audio-Video Accessories: Master controls for AV system.

1.03 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Manufacturer's catalog cuts and descriptive information on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Wiring diagrams for motor operators and actuators, and controls and switches.
- C. Shop Drawings: For custom installations, indicate dimensions, verified field measurements, mounting details, and interface with adjacent construction.
- D. Samples: For case and frame finishes, submit two samples 6 by 6 inch (152 by 152 mm) in size, illustrating color and texture of finish.
- E. Manufacturer's Qualification Statement.
- F. Installer's Qualification Statement.
- G. Operation and Maintenance Data: Provide manufacturer's operation and maintenance instructions.
- H. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver projection screens to project site in manufacturer's original unopened packaging, and inspect for damage and proper size before accepting delivery.
- B. Store in a protected, clean, dry area with temperature maintained above 50 degrees F (10 degrees C), and stack in accordance with manufacturer's recommendations.

- C. Acclimate screens to building temperatures for 24 hours prior to installation, in accordance with manufacturer's recommendations.

1.06 FIELD CONDITIONS

- A. Maintain interior of building between 60 degrees F (15 degrees C) and 75 degrees F (24 degrees C) during and after installation of projection screens.

1.07 WARRANTY

- A. See Section 01 77 00-Closeout Procedures, for additional warranty requirements.
- B. Provide 5 year manufacturer warranty for projection screen assembly.

PART 2 PRODUCTS

2.01 FRONT PROJECTION SCREENS

- A. Manufacturers:
 - 1. Bretford: www.bretford.com/#sle.
 - 2. Da-Lite Screen Company: www.da-lite.com/#sle.
 - 3. Draper, Inc (Motorized); Premier: www.draperinc.com/#sle.
 - 4. Draper, Inc (Manual); Luma Series: www.draperinc.com/#sle.
 - 5. Stewart Filmscreen Corporation: www.stewartfilmscreen.com/#sle.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Front Projection Screens: Factory assembled unless otherwise indicated.
 - 1. Dimensions: As indicated on drawings.
- C. Reflective Screen Fabric: Angularly reflective surface; flame retardant and mildew resistant.
 - 1. Material: Pearly finished vinyl without backing, with nominal gain of 1.5 on axis, not less than 0.75 at 35 degrees from axis.
 - 2. Seams: No seams permitted in fabric up to 96 inch (2438 mm) high by 72 inch (1829 mm) wide.
- D. Masking Borders: White, on four sides.
- E. Exposed Screen Cases: Steel, with integral roller brackets.
 - 1. Finish: Baked enamel.
 - 2. Color: White.
 - 3. End Caps: Steel; finished to match case.
 - 4. Provide wall valance to hide screen case when not in use.
 - 5. Provide supports for suspension from ceiling where indicated.
 - 6. Mounting: Wall.
- F. Concealed-in-Ceiling Screen Cases: Steel, with integral roller brackets.
 - 1. Door Slat: Self trim; self-closing and -opening.
 - 2. Case Finish: Baked enamel.
 - 3. Case Color: White.
 - 4. End Caps: Steel; finished to match case.
 - 5. Electrically-Operated Screens: 1-1/2 inch (38 mm) aluminum door roller.
- G. Electrically-Operated Screens:
 - 1. Roller: Steel, 2 inch (51 mm) in diameter, with locking device.
 - 2. Vertical Tensioning: Screen fabric weighted at bottom with steel bar and plastic end caps.
 - 3. Horizontal Tensioning: Tab-guided cable system.
- H. Provide mounting hardware, brackets, supports, fasteners, and other mounting accessories required for a complete installation, in accordance with manufacturer's recommendations for specified substrates and mountings.

2.02 ELECTRICAL COMPONENTS

- A. Electrical Components: Listed and classified by UL as suitable for the purpose specified and indicated.
- B. Motors: Direct drive, 110 V, 60 Hz.
 - 1. Screen Motor: Mounted inside roller; three wire with ground; quick reverse type and lifetime lubricated; equipped with thermal overload cut-off, internal junction box, electric brake, and pre-set accessible limit switches.
 - a. Electrical Characteristics: 1.2 amps.
 - b. Motor mounted on sound absorber.
 - 2. Door and Adjustable Masking Motor: Mounted inside roller; three wire with ground; quick reverse type; equipped with thermal overload cut-off.
 - a. Electrical Characteristics: 1.2 amps.
 - b. Motor mounted on sound absorber.
- C. Controls: Three (3) position control switch with plate.
 - 1. Provide two control stations to screen, with internal override to prevent more than one signal reaching the screen.
 - 2. In classrooms, provide control stations at front and rear of room.
 - 3. Remote Control: Infrared; provide one transmitter.
 - 4. Security: Provide key operated switch; provide 2 keys.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that substrate is finished and ready to accept screen installation.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that openings for recessed screens are correctly sized.
- D. Verify type and location of electrical connections.
- E. Do not install projection screens until climate control systems are in place and interior painting and other finishes are completed.

3.02 PREPARATION

- A. Coordinate screen installation with installation of projection systems.
- B. Coordinate installation with adjacent construction and fixtures, including ceilings, walls, lighting, fire suppression, and registers and grilles.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions, using manufacturer's recommended hardware for relevant substrates.
- B. Do not field cut screens.
- C. Install screens in mountings as specified and as indicated on drawings.
- D. Install plumb and level.
- E. Install electrically operated screens ready for connection to power and control systems.
- F. Adjust projection screens and related hardware in accordance with manufacturer's instructions for proper placement and operation.
- G. Test electrical screens for proper working condition. Adjust as needed.

3.04 PROTECTION

- A. Protect installed products until completion of project.
-

B. Touch up, repair, or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 11 81 29 FACILITY FALL PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Roof anchors.

1.02 RELATED REQUIREMENTS

- A. Section 05 21 00 - Steel Joist Framing
- B. Section 05 31 00 - Steel Decking
- C. Section 07 53 00 - EPDM Roofing : Coordination of anchor locations and materials with roofing product.
- D. 07 72 00 - Roof Accessories

1.03 DEFINITIONS

- A. Anchorage: A secure connecting point or a terminating component of a fall protection system or rescue system capable of safely supporting the impact forces applied by a fall protection system or anchorage subsystem.
- B. Anchorage Connector: A component or subsystem that functions as an interface between the anchorage and a fall protection, work positioning, rope access, or rescue system for the purpose of coupling the system to the anchorage.
- C. Fall Arrest System: A system designed to stop you in the process of a fall, typically including an anchor point or series of anchor points, a safety lanyard or self-retracting lifeline, and a harness.
- D. Fall Restraint System: A system designed to keep you from getting close enough to the fall hazard to fall, typically including an anchor point or series of anchor points, a safety lanyard or self-retracting lifeline, and a harness.
- E. Fall Protection System: System can be either a fall arrest or a fall restraint system.
- F. Lifeline: A component of a fall protection system consisting of a flexible line designed to hang vertically, a vertical lifeline, or connecting to anchorages or anchorage connectors at both ends to span horizontally, a horizontal lifeline.

1.04 REFERENCE STANDARDS

- A. 29 CFR 1910 - Occupational Safety and Health Standards; Current Edition.
- B. 29 CFR 1910.27 - Scaffolds and Rope Descent Systems; Current Edition.
- C. 29 CFR 1910.140 - Personal fall protection systems; Current Edition.
- D. 29 CFR 1910.66 - Powered Platforms for Building Maintenance; Current Edition.
- E. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.
- F. 29 CFR 1926.502 - Fall protection systems criteria and practices; Current Edition.
- G. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).
- H. AISC 360 - Specification for Structural Steel Buildings; 2022.
- I. ANSI/ASSP Z359.7 - Qualification and Verification Testing of Fall Protection Products; 2019.
- J. ANSI/ASSP Z359.18 - Safety Requirements for Anchorage Connectors for Active Fall Protection Systems; 2017, with Errata (2021).
- K. ANSI/IWCA I-14 - Window Cleaning Safety Standard; 2001.
- L. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

- M. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2022.
- N. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- O. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- P. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- Q. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- R. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- S. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- T. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.
- U. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.
- V. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.
- W. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.
- X. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- Y. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- Z. ISO/IEC 17025 - General Requirements for the Competence of Testing and Calibration Laboratories; 2017.
- AA. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
- BB. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate installation of roof anchors with Structural Engineer, Architect, and Roofing Installer to verify installation will result in a warrantable building envelope.

1.06 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Material, equipment, and fixture lists. Manufacturer's catalog data indicating the sizes, descriptions, capacities, test certifications, and other descriptive data showing in sufficient detail that product complies with contract requirements. Equipment and performance data including but not limited to lifeline anchors, safety tieback anchors, and lifeline cable.
- C. Shop Drawings: Installation details: plan showing locations and types of anchorage points for personal fall protection systems and building maintenance equipment.
 - 1. Detail mounting, securing, and flashing of roof-mounted items to roof structure. Indicate coordinating requirements with roof membrane system.
 - 2. Indicate anchorage details and quantity, diameter, and depth of penetration of anchors.
- D. Manufacturer's Installation Instructions: Instructions indicating recommended method and sequence of installation for lifeline anchors, safety tieback anchors, energy-absorbing devices, and lifeline cable.
- E. Manufacturer's qualification statement.

- F. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated within the previous 12 months.
- G. Installer's qualification statement.
- H. Testing agency's qualification statement.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least five years of documented experience.
- B. Welder Qualifications: Welding processes and welding operators qualified within previous 12 months.
- C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.

1.08 WARRANTY

- A. See Section 01 77 00-Closeout Procedures for additional warranty requirements.
- B. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 ROOF ANCHORS

- A. Manufacturers:
 - 1. FallTech; www.falltech.com
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Application:
 - 1. OSHA and ANSI one person PPE anchor.
 - 2. OSHA HLL end anchors.
 - 3. OSHA HLL intermediate anchors.
- C. Description:
 - 1. Roof anchorage points for personal fall protection systems; used exclusively for employee fall protection and independent of any anchorage used to suspend employees or platforms on which employees work.
 - a. Anchor Type per ANSI/ASSP Z359.18: Type T.
- D. Structural Performance: Provide safety tieback anchors capable of withstanding design loads as required by governing regulations and codes.
- E. Design Criteria: Fall protection anchors.
 - 1. Comply with 29 CFR 1910.140 and 29 CFR 1926.502 for personal fall protection systems and anchorage.
 - 2. Comply with 29 CFR 1926, Subpart M-Fall Protection.
 - 3. Comply with ANSI/ASSP Z359.18 test requirements for static strength, dynamic strength, residual strength, serviceability, and corrosion of anchorage.
 - a. Testing Labs: Meet requirements of ANSI/ASSP Z359.7 and ISO/IEC 17025.
- F. Provide permanent labels with manufacturer's name, serial number, manufacturing date, and rated load on commercial roof anchors.
- G. Anchors:
 - 1. FallTech #78012CSWE Post Anchor with Welded-eye for Concrete and Steel
 - 2. Type: Vertical galvanized carbon steel pipe with fixed U-bar.
 - a. Loop Diameter: 1.25" x 2" welded eye
 - b. Pier:

- 1) Height: 18 inches (457 mm).
- 2) Diameter: 3-inch (76-mm) OD. minimum
- 3) Wall Thickness: Schedule 40.
- 4) Material: Hot-dip galvanized steel pipe.
- c. Flat baseplate, factory-welded.
 - 1) Size: 12 inches (305 mm) square.
 - 2) Thickness: 1/2 inch (12.7 mm).
 - 3) Material: Hot-dip galvanized steel.
 - 4) Bolt Holes: Eight, 9/16-inch (14 mm) ID holes.
- H. Anchor Installation:
 1. Type: Through-bolted.
 2. Anchor Substrate: Metal decking.
 3. Roofing Material: As indicated on drawings.
 4. Flashing Material: Premolded pipe flashing, membrane flashing, or sealant acceptable to roof manufacturer.

2.02 MATERIALS - STEEL

- A. Structural Steel Sections: ASTM A36/A36M.
- B. Steel Plates, Shapes, and Bars: ASTM A6/A6M or ASTM A283/A283M.
- C. Steel Pipe: ASTM A53/A53M Grade B Schedule 40, black finish.
- D. Steel Tubing: ASTM A500/A500M or ASTM A501/A501M structural tubing, round and shapes as indicated.
- E. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- F. Steel Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, and galvanized in accordance with ASTM A153/A153M where connecting galvanized hardware components.
- G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- H. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.03 FABRICATION

- A. Fabricate work true to dimension, square, plumb, level, and free from distortion or defects detrimental to appearance and performance.
- B. Grind off surplus welding material and ensure exposed internal corners have smooth lines.
- C. Fabricate system components of the same material unless otherwise indicated.
- D. Fabricate anchoring devices as recommended by the manufacturer to provide adequate support for intended use.
- E. Fabricate joints in a manner to discourage water accumulation. Provide weep holes to drain all water that could accumulate in the exposed joints.

2.04 FINISHES

- A. Galvanizing: Hot-dip galvanize to minimum requirements of ASTM A123/A123M.
 1. Touch up abraded areas after fabrication using specified touch-up primer for galvanized surfaces.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine area for compliance with requirements for installation tolerances and other conditions related to this work.

- B. Confirm that the ladder structure to which the ladder safety system is installed can withstand the loads applied by the system in the event of a fall.
- C. Proceed with installation after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Coordinate location of fall protection equipment indicated to be attached to structural substrate or surface of roofing system and provide anchoring devices with templates, diagrams, and installation instructions.

3.03 INSTALLATION

- A. Install anchorage and fasteners in accordance with shop drawings and manufacturer's recommendations to obtain allowable working loads published in product literature and in accordance with this specification.
- B. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous coating or by other permanent separation as recommended by fall protection system manufacturer.
- C. Deform threads of tail end of anchor studs after nuts have been tightened to prevent accidental removal or vandalism.
- D. Do not load or stress anchors until all materials and fasteners are properly installed and ready for service.
- E. Seal roof penetrations at anchors with pre-molded pipe flashing, membrane flashing, or sealant acceptable to roof manufacturer.
- F. Install all roof safety anchors a minimum of 6 feet (1.83 m) from the roof edge.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 45 16-Field Quality Control Procedures for City of Madison requirements for additional requirements.
- B. Test anchorage systems using only chemical adhesive fasteners on-site using load cell test apparatus in accordance with manufacturer's recommendations.
- C. Load test anchors under the direct supervision of a licensed engineer in accordance with ACI CODE-318, AISC 360, ASCE 7, ICC (IBC), 29 CFR 1910.27, and 29 CFR 1910.66 requirements.
- D. Inspect each anchor for conformance to manufacturer requirements, building envelope, looseness, and signs of permanent deflection during load testing.

3.05 ADJUSTING

- A. Adjust fall protection components to function smoothly and safely.

3.06 CLEANING

- A. See Section 01 77 00-Closeout Procedures for additional requirements.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing in accordance with ASTM A780/A780M.
- C. Clean exposed surfaces in accordance with fall protection system manufacturer's written instructions.

3.07 CLOSEOUT ACTIVITIES

- A. See Section 01 77 00-Closeout Procedures for closeout submittals.
- B. See Section 01 79 00 - Demonstration and Training for additional requirements.
- C. Demonstration: Demonstrate operation of system to Owner's personnel.
 - 1. Use operation and maintenance data as reference during demonstration.
 - 2. Briefly describe function, operation, and maintenance of each component.
- D. Training: Train Owner's personnel on operation and maintenance of system.

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: Manufacturer's training personnel.
4. Location: At project site.

3.08 MAINTENANCE

- A. See Section 01 77 00-Closeout Procedures for additional requirements relating to maintenance service.
- B. 29 CFR 1910 and ANSI/IWCA I-14 require that anchors first be certified and subsequently inspected on an annual basis. Coordinate with manufacturer and local inspectors as required to maintain compliance.
- C. Provide a separate maintenance contract for specified maintenance service.

END OF SECTION

**SECTION 12 24 00
WINDOW SHADES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Interior manual roller shades.
- B. Interior motorized roller shades.
- C. Motor controls.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Concealed wood blocking for attachment of head rail brackets.
- B. Section 26 27 26 - Wiring Devices: Finish requirements for wall controls specified in this section.

1.03 REFERENCE STANDARDS

- A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015, with Editorial Revision (2021).
- B. C2C (DIR) - C2C Certified Products Registry; Cradle to Cradle Products Innovation Institute Current Edition.
- C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films 2023, with Errata.
- E. UL (GGG) - GREENGUARD Gold Certified Products Current Edition.
- F. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems Current Edition, Including All Revisions.
- G. WCMA A100.1 - Standard for Safety of Window Covering Products 2022.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Where motorized shades are to be controlled by control systems provided under other sections, coordinate the work with other trades to provide compatible products.
 - 2. Coordinate the work with other trades to provide rough-in of electrical wiring as required for installation of hardwired motorized shades.
- B. Pre-installation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of affected installers.
- C. Sequencing:
 - 1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
 - 2. Do not install shades until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
 - 1. Motorized Shades: Include power requirements and standard wiring diagrams for specified products.
- C. Shop Drawings: Include shade schedule indicating size, location and keys to details; head, jamb and sill details; mounting dimension requirements for each product and condition; operation direction.

1. Motorized Shades: Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.
- D. Certificates: Manufacturer's documentation that line voltage components are UL listed or UL recognized.
- E. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.
- F. Selection Samples: Include fabric samples in full range of available colors and patterns;
 1. Motorized Shades: Include finish selections for controls.
- G. Verification Samples: Minimum size 6 inches (150 mm) square, representing actual materials, color and pattern.
- H. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- I. Project Record Documents: Record actual locations of control systems and show interconnecting wiring.
- J. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.
- K. LEED Submittals: Provide documentation of how the requirements of credit will be met.
- L. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- M. Maintenance contracts.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of this type with minimum 5 years of documented experience with shading systems of similar size and type.
 1. Manufacturer's authorized representative.
 2. Factory training and demonstrated experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 MOCK-UP

- A. Mock-Up: Provide full size mock-up of window shade system complete with selected shade fabric including example of seams; batten pockets; and when applicable.
 1. Obtain Architect's approval of light and privacy characteristics of fabric prior to fabrication.
 2. Full-sized mock-up may become part of the final installation.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.
- B. Handle and store shades in accordance with manufacturer's recommendations.

1.09 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.10 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
 1. Shade Hardware.
 2. Electric Motors.

3. Electronic Control Equipment.
4. Fabric.
5. Aluminum and Steel Coatings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Interior Manually Operated Roller Shades:
 1. Draper, Inc; Clutch Operated FlexShade; Clutch Operated FlexShade XD; Manual LightBloc FlexShade
 2. Hunter Douglas Architectural; RB500 Manual Roller Shades
 3. Lutron Electronics Co., Inc; Contract Roller Manual Roller Shades
 4. MechoShade Systems LLC; Mecho/7 System; UrbanShade Single Roller - Manual
 5. SWFcontract, a division of Springs Window Fashions, LLC; Pro Series Manual Solar Shade System
 6. Levolor Roller Shades
 7. Substitutions: See Section 01 60 00 - Product Requirements
- B. Interior Motorized Roller Shades, Motors and Motor Controls:
 1. Draper, Inc; Motorized FlexShade; Motorized LightBloc FlexShade
 2. Hunter Douglas Architectural; RB500 Motorized Roller Shades
 3. Levolor; Motorized Roller Shade
 4. Lutron Electronics Co., Inc; Contract Roller Motorized Roller Shades
 5. MechoShade Systems LLC; UrbanShade Single
 6. SWFcontract, a division of Springs Window Fashions, LLC
 7. Substitutions: See Section 01 60 00 - Product Requirements
- C. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

2.02 ROLLER SHADES

- A. General:
 1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
 2. Provide shade system that operates smoothly when shades are raised or lowered.
 3. Provide shade system that is Cradle-to-Cradle certified and listed in C2C (DIR).
 4. Motorized Shades: Motor system housed inside roller tube, controlling shade movement via motor controls indicated; listed or recognized to UL 325.
 - a. Comply with NFPA 70.
 - b. Electrical Components: Listed, classified, and labeled as suitable for the purpose intended. Where applicable, system components to be FCC compliant.
 - c. Motors: Size and configuration as recommended by manufacturer for the type, size, and arrangement of shades to be operated; integrated into shade operating components and concealed from view; fully compatible with controls to be installed.
- B. Roller Shades
 1. Description - Interior Roller Shades: Single roller, manually operated; motor operated; fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
 - a. Drop Position: Regular roll
 - b. Roll Direction: Roll down, closed position varies by condition.
 - c. Roll Direction: Bottom-up, closed position is at top of window opening.
 - d. Mounting: Window jamb mounted on face of jambs.
 - e. Size: As indicated on drawings.
 - f. Fabric: 5% Openness and Black Out as indicated on drawings.

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- g. Color: SWF Contract Crosshatch R, Charcoal Gray.
 2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
 - a. Material: Stamped steel.
 - b. Multiple Shade Operation: Provide hardware as necessary to operate more than one shade using a single clutch operator; motor.
 3. Roller Tubes: As required for type of shade operation.
 - a. Material: Extruded aluminum, clear anodized finish.
 - b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
 - c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge.
 - d. Take-Up Roller: Manufacturer's standard roller tube pre-tensioned for winding lift cable in bottom-up type shades.
 4. Hembars: Designed to maintain bottom of shade straight and flat.
 - a. Style: Full wrap; fabric covered bottom bar, flat profile with heat sealed closed ends.
 - b. Room-Darkening Shades: Provide a slot in bottom bar with wool-pile light seal.
 5. Manual Operation for Interior Shades:
 - a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
 - b. Drive Chain: Continuous loop beaded ball chain, 95lb (43 kg) minimum breaking strength. Provide upper and lower limit stops.
 - c. Shade Lift Assistance: Manufacturer's standard spring device contained in the idler end of roller tube to reduce force required to lift shades; as required based on shade weight.
 - d. Chain Retainer:
 - 1) Chain tensioning device complying with WCMA A100.1.
 - 2) Manufacturer's standard clip.
 6. Manual Operation for Exterior Shades: Crank operated; removable powder coated steel crank with handle.
 7. Accessories:
 - a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; baked enamel finish.
 - 1) Color: Match shade color.
 - 2) Profile: Square.
 - b. End Caps: Provide manufacturer's standard end caps to cover exposed ends of brackets.
 - c. Interior Side Channels: As required for light sealing room-darkening shade applications.
 - d. Lifting Cables: Nylon coated cable for lifting bottom-up type shades.
 - e. Fasteners: Noncorrosive, and as recommended by shade manufacturer.
 - f. Finish: Manufacturer's standard finish, unless otherwise indicated
 - g. Quantity: As indicated on drawings

2.03 ROLLER SHADE FABRICATION

- A. Field measure finished openings prior to ordering or fabrication.
 - B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
 1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch (13 mm) space between bottom bar and window sill or as indicated on drawings.
 2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb.
 3. Horizontal Dimensions - Inside Mounting: Provide symmetrical light gaps on both sides of shade not to exceed 1/2 inch total.
 4. Horizontal Dimensions - Outside Mounting: Cover window frames, trim, and casings completely.
 5. Horizontal Dimensions - Outside Mounting: Extend shades 2 inches beyond jambs on each side.
 - C. Dimensional Tolerances: As recommended in writing by manufacturer.
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- D. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine finished openings for deficiencies that may preclude satisfactory installation.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

- A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
- B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
- B. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.
- C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 SYSTEM STARTUP

- A. Motorized Shade System: Provide services of a manufacturer's authorized representative to perform system startup.

3.05 CLEANING

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.
- C. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

3.06 CLOSEOUT ACTIVITIES

- A. See Section 01 77 00-Closeout Procedures.s, for closeout submittals.
- B. See Section 01 79 00 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.
- D. Training: Train Owner's personnel on operation and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours training by manufacturer's authorized personnel at location designated by the Owner.

3.07 PROTECTION

- A. Protect installed products from subsequent construction operations.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.

3.08 MAINTENANCE

- A. See Section 01 77 00-Closeout Procedures, for additional requirements relating to maintenance service.

- B. Provide to Owner at no extra cost a separate maintenance contract for the service and maintenance of a motorized shade system for two years from date of Substantial Completion. Include a complete description of preventive maintenance, systematic examination, adjustment, parts and labor, cleaning, and testing, with a detailed schedule.

END OF SECTION

**SECTION 12 32 00
MANUFACTURED WOOD CASEWORK**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufactured standard casework, with cabinet hardware.

1.02 RELATED REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Requirements for sustainably harvested wood.
- B. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: VOC limitations for adhesives and sealants.
- C. Section 06 10 00 - Rough Carpentry: Blocking and nailers for anchoring casework.
- D. Section 06 41 00 - Architectural Wood Casework; circulation desk.
- E. Section 07 92 00 - Joint Sealants: Sealing joints between casework and countertops and adjacent walls, floors, and ceilings.
- F. Section 09 21 16 - Gypsum Board Assemblies: Reinforcements in metal-framed partitions for anchoring casework.
- G. Section 09 65 00 - Resilient Flooring: Resilient wall base.
- H. Section 11 30 13 - Residential Appliances: Coordination of clear opening sizes for appliances.
- I. Section 12 36 00 - Countertops: Additional requirements for countertops.
- J. Section 22 40 00 - Plumbing Fixtures: Sinks and fittings installed in casework.
- K. Section 26 27 26 - Wiring Devices: Switches, receptacles installed in casework.

1.03 DEFINITIONS

- A. Exposed: Portions of casework visible when drawers and cabinet doors are closed, including end panels, bottoms of cases more than 42 inches (1.066 m) above finished floor, tops of cases less than 72 inches (1.82 m) above finished floor and all members visible in open cases or behind glass doors.
- B. Semi-Exposed: Portions of casework and surfaces behind solid doors, tops of cases more than 72 inches (1.828 m) above finished floor and bottoms of cabinets more than 30 inches (0.762 m) but less than 42 inches (1.066 m) above finished floor.
- C. Concealed: Sleepers, web frames, dust panels and other surfaces not generally visible after installation and cabinets less than 30 inches (762 mm) above finished floor.

1.04 REFERENCE STANDARDS

- A. AWI (QCP) - Quality Certification Program; Current Edition.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- D. BHMA A156.9 - Cabinet Hardware; 2020.
- E. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2020.
- F. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Keying Conference: Conduct conference prior to ordering keys. Incorporate conference decisions into keying submittal.

1.06 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include rough-in and anchors and reinforcements, placement dimensions and tolerances, clearances required, and keying information.
- C. Samples for Hardware: provide standard number of samples to Architect.
- D. Samples for Finish Selection: Fully finished, for color selection. Minimum sample size: 2 inches by 3 inches (51 mm by 75 mm).
- E. Maintenance Data: Manufacturer's recommendations for care and cleaning.
- F. Finish touch-up kit for each type and color of materials provided.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Quality Certification: Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
 - 1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 2. Provide designated labels on shop drawings as required by certification program.
 - 3. Provide designated labels on installed products as required by certification program.
 - 4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
 - 5. Replace, repair, or rework all work for which certification is refused.
- C. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience and approved by manufacturer.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect items provided by this section, including finished surfaces and hardware items during handling and installation. For metal surfaces, use polyethylene film or other protective material standard with the manufacturer.
- B. Acceptance at Site:
 - 1. Do not deliver or install casework until the conditions specified under Part 3, Examination Article of this section have been met. Products delivered to sites that are not enclosed and/or improperly conditioned will not be accepted if warping or damage due to unsatisfactory conditions occurs.
- C. Storage:
 - 1. Store casework in the area of installation. If necessary, prior to installation, temporarily store in another area, meeting the environmental requirements specified under Part 3, "Site Verification of Conditions" Article of this section.

1.09 WARRANTY

- A. See Section 01 77 00-Closeout Procedures for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion, at no additional cost to Owner. Defects include, but are not limited to:
 - 1. Ruptured, cracked, or stained finish coating.
 - 2. Discoloration or lack of finish integrity.
 - 3. Cracking or peeling of finish.
 - 4. Failure of hardware.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Plastic Laminate Casework:
 - 1. Smart Cabinetry; Tahoe, www.smartcabinetry.com.
 - 2. Quest Cabinets; Pure, <https://www.questcabinets.com/>
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Obtain casework from single source and manufacturer, unless otherwise indicated.

2.02 CASEWORK, GENERAL

- A. Quality Standard: AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Faced Cabinets: Custom Grade.

2.03 FABRICATION

- A. Assembly: Shop assemble casework items for delivery to site in units easily handled and to permit passage through building openings.
- B. Construction: As required for selected grade.
- C. Access Panels: Where indicated, for maintenance of utility service and mechanical and electrical components.
- D. Removable back panels on indicated base cabinets. Provide partial height back panels at sink cabinets.
- E. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- F. Scribes and Fillers: Panels of matching construction and finish, for locations where cabinets do not fit tight to adjacent construction.
- G. Apron Frames: Construction similar to other cabinets, with modifications.
 - 1. Frames fabricated from panels standard with the manufacturer. Include front and back panels, with drawer suspension framing mechanically fastened to support channels spanning between them.

2.04 PLASTIC-LAMINATE-CLAD CASEWORK

- A. Plastic-Laminate-Clad Casework: Solid wood and wood panel construction; each unit self-contained and not dependent on adjacent units or building structure for rigidity; in sizes necessary to avoid field cutting except for scribes and filler panels. Include adjustable levelers for base and tall cabinets.
 - 1. Style: Flush overlay. Ease doors and drawer fronts slightly at edges.
 - 2. Cabinet Nominal Dimensions: Unless otherwise indicated, provide cabinets of widths and heights indicated on drawings, and with following front-to-back dimensions:
 - a. Base Cabinets: 22 inches (559 mm).
 - b. Tall Cabinets: 24 inches (609 mm).
 - c. Wall Cabinets: 13 inches (330 mm).
 - 3. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline.
 - a. Finish: Matte or suede, gloss rating of 5 to 20.
 - b. Surface Color and Pattern: As indicated on drawings.
 - c. Exposed Interior Surfaces: Thermally fused laminate.
 - 1) Color: White.
 - d. Cap exposed plastic laminate finish edges with material of same finish and pattern.

2.05 COUNTERTOPS

- A. Countertops: See Section 12 36 00.

2.06 CABINET HARDWARE

- A. Manufacturer's standard types, styles and finishes.
- B. Comply with BHMA A156.9 requirements.
 - 1. Acceptable base materials for plated finishes include brass, bronze, and steel.

2.07 MATERIALS

- A. Adhesives Used for Assembly: Comply with VOC requirements for adhesives and sealants; see Section 01 61 16.
- B. Wood-Based Materials:
 - 1. Certified as sustainably harvested; see Section 01 60 00.
 - 2. Solid Wood: Air-dried to 4.5 percent moisture content, then tempered to 6 percent moisture content before use.
 - 3. Composite Wood Panels: Containing no urea-formaldehyde resin binders.
- C. Solid Wood: Clear, dry, sound, plain sawn, selected for compatible species, grain and color, no defects.
- D. Semi-Exposed Solid Wood: Dry, sound, plain sawn, no appearance defects, any species similar in color and grain to exposed portions.
- E. Hardwood Plywood: Veneer core; HPVA HP-1 Grade as indicated; same species as exposed solid wood, clear, compatible grain and color, no defects. Band exposed edges with solid wood of same species as veneer.
- F. Concealed Solid Wood or Plywood: Any species and without defects affecting strength or utility.
- G. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications, complying with Grade requirements, and standard with the manufacturer.

2.08 ACCESSORIES

- A. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- B. Concealed Joint Fasteners: Corrosion-resistant, standard with manufacturer.
- C. Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color to match adjacent surface.
- D. Sealant for Use in Casework Installation:

PART 3 EXECUTION**3.01 PREPARATION**

- A. Large Components: Ensure that large components can be moved into final position without damage to other construction.

3.02 EXAMINATION

- A. Site Verification of Environmental Conditions:
 - 1. Do not deliver casework until the following conditions have been met:
 - a. Building has been enclosed (windows and doors sealed and weather-tight).
 - b. An operational HVAC system that maintains temperature and humidity at occupancy levels has been put in place.
 - c. Ceiling, overhead ductwork, piping, and lighting have been installed.
 - d. Installation areas do not require further "wet work" construction.

- B. For Base Cabinets Installation: Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than 1/2 inch (13 mm) leveling adjustment. When installation conditions are acceptable, for each space, establish the high point of the floor. Set and make level and plumb first cabinet in relation to this high point.
- C. For Wall Cabinets Installation: Examine wall surfaces in installation space. Do not proceed with installation if the following conditions are encountered:
 - 1. Maximum variation from plane of masonry wall exceeds 1/4 inch in 10 ft (6 mm/3 m) and 1/2 inch in 20 ft (13 mm/6 m) or more, and/or maximum variation from plumb exceeds 1/4 inch (6 mm) per story.
 - 2. Maximum Variation of finished gypsum board surface from true flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.
- D. Verify adequacy of support framing and anchors.
- E. Verify that service connections are correctly located and of proper characteristics.

3.03 INSTALLATION

- A. Perform installation in accordance with manufacturer's instructions.
- B. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only where allowed by approved shop drawings, or where concealed fasteners are impracticable.
- C. Set casework items plumb and square, securely anchored to building structure.
- D. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.
- E. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch (1.6 mm). In addition, do not exceed the following tolerances:
 - 1. Variation of Tops of Base Cabinets from Level: 1/16 inch (1.6 mm) in 10 feet (3 m).
 - 2. Variation of Bottoms of Wall Cabinets from Level: 1/8 inch (3 mm) in 10 feet (3 m).
 - 3. Variation of Faces of Cabinets from a True Plane: 1/8 inch (3 mm) in 10 feet (3 m).
 - 4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch (0.8 mm).
 - 5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch (1.6 mm).
- F. Secure wall and floor cabinets to concealed reinforcement at gypsum board assemblies.
- G. Base Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than 16 inches (407 mm) on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.
 - 1. Where base cabinets are installed away from walls or service space framing, anchor to floor at toe space at not more than 24 inches (610 mm) on center, and at sides of cabinets with not less than two fasteners per side.
- H. Wall Cabinets: Fasten to hanging strips, and/or wall substrates. Fasten each cabinet through back, near top, at not less than 16 inches (407 mm) on center.
- I. Install hardware uniformly and precisely.
- J. Countertops: Install countertops intended and furnished for field installation in one true plane, with ends abutting at hairline joints, and no raised edges.
- K. Replace units that are damaged, including those that have damaged finishes.

3.04 ADJUSTING

- A. Adjust operating parts, including doors, drawers, hardware, and fixtures to function smoothly.

3.05 CLEANING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.
- B. Clean casework and other installed surfaces thoroughly.

3.06 PROTECTION

- A. Do not permit finished casework to be exposed to continued construction activity.
- B. Protect casework and countertops from ongoing construction activities. Prevent workmen from standing on, or storing tools and materials on casework or countertops.
- C. Repair damage, including to finishes, that occurs prior to Date of Substantial Completion, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

END OF SECTION

**SECTION 12 36 00
COUNTERTOPS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Countertops for architectural wood casework.
- B. Countertops for manufactured casework.
- C. Wall-hung counters and vanity tops.
- D. Sinks molded into countertops.
- E. Window sills.

1.02 RELATED REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Requirements for sustainably harvested wood.
- B. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: VOC limitations for adhesives and sealants.
- C. Section 06 10 00 - Rough Carpentry: Blocking and nailers for anchoring casework.
- D. Section 06 41 00 - Architectural Wood Casework.
- E. Section 07 92 00 - Joint Sealants: Sealing joints between casework and countertops and adjacent walls, floors, and ceilings.
- F. Section 12 32 00 - Manufactured Wood Casework
- G. Section 22 40 00 - Plumbing Fixtures: Sinks.

1.03 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
- C. AWI (QCP) - Quality Certification Program; Current Edition.
- D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- E. AWMAC (GIS) - Guarantee and Inspection Services Program; Current Edition.
- F. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- G. IAPMO Z124 - Plastic Plumbing Fixtures; 2022, with Editorial Revision.
- H. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- I. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- J. PS 1 - Structural Plywood; 2019.
- K. WI (CCP) - Certified Compliance Program (CCP); Current Edition.

1.04 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
- C. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Natural Stone Institute (NSI) Accredited Natural Stone Fabricator; www.naturalstoneinstitute.org/#sle.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
- C. Quality Certification:

1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
2. Comply with AWMAC (GIS) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
3. Comply with WI (CCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.woodworkinstitute.com/#sle.
4. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
5. Provide designated labels on shop drawings as required by certification program.
6. Provide designated labels on installed products as required by certification program.
7. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 COUNTERTOPS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
 1. Laminate Sheet: NEMA LD 3, Grade HGS, 0.048 inch (1.2 mm) nominal thickness.
 - a. Manufacturers:
 - 1) See Material Schedule on drawings for specific product and manufacturer and locations.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 - (a) Substitutions are permitted pending color and pattern match to product specified.
 - b. Laminate Core Color: Same as decorative surface.
 - c. Finish: Matte or suede, gloss rating of 5 to 20.
 - d. Surface Color and Pattern: As indicated on drawings.
 2. Exposed Edge Treatment: Square, substrate built up to minimum 1-1/4 inch (32 mm) thick; covered with matching laminate.
 3. Back and End Splashes: Same material, same construction. 4 inches high.
 4. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Custom Grade.
- C. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
 1. Flat Sheet Thickness: 1/2 inch (12 mm), minimum.
 2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Manufacturers:
 - 1) Avonite Surfaces: www.avonitesurfaces.com/#sle.
 - 2) Dupont: www.corian.com/#sle.
 - 3) Wilsonart: www.wilsonart.com/#sle.

- 4) Substitutions: See Section 01 60 00 - Product Requirements.
- b. Sinks and Bowls: Integral castings; minimum 3/4 inch (19 mm) wall thickness; comply with IAPMO Z124.
- c. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
- d. Color and Pattern: As indicated on drawings.
3. Other Components Thickness: 1/2 inch (12 mm), minimum.
4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch (32 mm) thick; square edge; use marine edge at sinks.
5. Back and End Splashes: Same sheet material, square top; minimum 4 inches (102 mm) high.

2.02 MATERIALS

- A. Wood-Based Components:
 1. Wood fabricated from old growth timber is not permitted.
 2. Provide wood harvested within a 500 mile (805 km) radius of the project site.
 3. Wood fabricated from timber recovered from riverbeds or otherwise abandoned is permitted, unless otherwise noted, provided it is clean and free of contamination; identify source; provide lumber re-graded by an inspection service accredited by the American Lumber Standard Committee, Inc.
- B. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.
- C. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf (20 kg/cu m) minimum density; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.
- D. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.
- E. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
- F. Joint Sealant: Mildew-resistant silicone sealant, white.

2.03 ACCESSORIES

- A. Fixed Top-Mounted Countertop Support Brackets:
 1. Material: Steel.
 2. Finish: Manufacturer's standard, factory-applied, textured powder coat.
 3. Color: Black.
 4. Products:
 - a. Centerline Brackets; Front Mounting Countertop Support: www.countertopbracket.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
 1. Join lengths of tops using best method recommended by manufacturer.
 2. Fabricate to overhang fronts and ends of cabinets 1 inch (25 mm) except where top butts against cabinet or wall.
 - a. Rout a 1/8 inch (3 mm) drip groove at underside of exposed overlapping edges, set back 1/2 inch (13 mm) from face of edge.
 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
 1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
 2. Height: 4 inches (102 mm), unless otherwise indicated.
- C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches (3,657 mm) long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

1. Integral sinks: Shop-mount securely to countertop with adhesives, using flush configuration, as per manufacturer's instructions, and as detailed on drawings.
- D. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install vanities in accordance with manufacturer's instructions and approved shop drawings
- B. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- C. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch (16 mm).
- D. Seal joint between back/end splashes and vertical surfaces.

3.04 TOLERANCES

- A. Variation From Horizontal: 1/8 inch in 10 feet (3 mm in 3 m), maximum.
- B. Offset From Wall, Countertops: 1/8 inch (3 mm) maximum; 1/16 inch (1.5 mm) minimum.
- C. Field Joints: 1/8 inch (3 mm) wide, maximum.

3.05 CLEANING

- A. Clean countertops surfaces thoroughly.

3.06 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 13 34 16
PRE-ENGINEERED STRUCTURES - SOLAR FORMA

PART 1 GENERAL

1.01 SUMMARY

- A. Provide required infrastructure to support FUTURE pre-engineered structures as shown and as specified. Comply with applicable provisions of Divisions 00 and 01.
- B. Section includes pre-engineered structures for:
 - 1. Shade Structure

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete encasement of conduits; foundation for structure.
- B. Section 26 05 33.13 - Conduit for Electrical Systems.
- C. Section 26 05 33.16 - Boxes for Electrical Systems.
- D. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

1.03 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for City of Madison required submittal procedures.
- B. Shop Drawings: Submit shop drawing, including complete erection drawings, framing members and details, wind bracing details, column schedule, and (where applicable) provisions for accommodation of electrical equipment. Include foundation and structural design calculations. Shop drawings and design calculations shall be sealed by a professional engineer registered in the State of Wisconsin.
- C. Samples: Submit color samples for selection/verification of finish colors.
- D. Warranty: Submit written warranty as specified below.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Protect products after arrival at destination from weather, sunlight, and damage.
- B. Store products elevated to allow air circulation and to not introduce mold, fungi decay, or insects to the product.
- C. Handle products with protective straps or padded forks if lifted with mechanical equipment. Use of chain or cable to lift product into place will not be accepted.
- D. To curtail warping of lumber, all units shall remain packaged while being stored.

1.05 WARRANTY

- A. Structures shall have a 10-year limited warranty on steel frame members and a 10-year limited warranty on paint system.
- B. For photovoltaic (PV) panels, micro inverters and other solar-related electrical equipment shall have a 10-year warranty.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURER

- A. Pre-engineered solar powered shade structures shall be manufactured by Solar Forma Design, 1106 Mondovi Road, Eau Claire, WI 54701.
 - B. Representative for Solar Forma Design is Engineered Representation, Inc.
 - 1. Contact: Jeff Gatzow.
 - 2. Phone: 414-458-9074.
 - 3. email: jg@engineeredrepinc.com
 - C. Substitutions: No "or equal" products or substitutions will be allowed.
-

2.02 DESIGN REQUIREMENTS

- A. Foundation and structural design shall be the responsibility of structure manufacturer.
- B. Design, manufacture, and erection shall conform to the following code:
 - 1. Wisconsin Commercial Building Code (Wis. Adm. Code, chs. SPS 361 to 366).
- C. Structures shall be designed to support construction loads and the structural loads as required by the referenced building code.

2.03 SHADE STRUCTURES

- A. Model: Qty (1) E2 (B/17') Model. Location provided on plans .
- B. Solar PV:
 - 1. 708 cells, min. 3.5Kw and temperature range of -40-degree C. to +65 degrees C.
- C. Lighting: Internally lighted
- D. Power: (1) GFI outlet per tree, by Electrical Contractor.
- E. Mounting: Concrete foundation per manufacturers recommendations.

PART 3 EXECUTION**3.01 ERECTION**

- A. Erect structures in accordance with shop drawings and manufacturer's recommendations. Coordinate the work of other trades to facilitate the general progress of the work.

CLEAN-UP

- A. Upon completion, clean panels, and other components to remove construction staining and dirt, and repair defects which might detract from visual appearance of structures.

END OF SECTION

SECTION 13 46 13
LIGHTNING PROTECTION FOR STRUCTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Strike (air) terminals and interconnecting conductors.
- B. Grounding and bonding for lightning protection.

1.02 RELATED REQUIREMENTS

- A. Surge Protection for Wiring Systems: Specified in individual system requirements.

1.03 REFERENCE STANDARDS

- A. NFPA 780 - Standard for the Installation of Lightning Protection Systems; 2023.
- B. UL 96 - Lightning Protection Components; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene meeting at least at least two weeks prior to commencement of work affected by lightning protection system requirements to discuss prerequisites and coordination required by other installers; require attendance by representatives of installers whose work will be affected.

1.05 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures.
- B. Installation Certification: Submit copy of certification agency's approval.

1.06 QUALITY ASSURANCE

- A. Maintain one copy of each referenced system design standard on site.
- B. Designer Qualifications: Person or entity, employed by installer, who specializes in lightning protection system design with minimum three years documented experience.
- C. Installer Qualifications: Capable of providing specified certification of installed system.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Lightning Protection Components:
 - 1. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
 - 2. Harger Lightning and Grounding: www.harger.com/#sle.
 - 3. National Lightning Protection Corporation: www.theprotectionsource.com/#sle.
 - 4. nVent ERICO; System 2000: www.nvent.com/#sle.
 - 5. Robbins Lightning, Inc: www.robbsinlightning.com/#sle.
 - 6. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.
 - 7. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 LIGHTNING PROTECTION SYSTEM

- A. Lightning Protection System: Provide complete system complying with NFPA 780, including air terminals, bonding, interconnecting conductors and grounding electrodes.
 - 1. Provide system that protects:
 - a. Entire structure.
 - b. Open air areas within 100 feet (30 meters) of exterior walls at grade level.
 - c. Open air areas within building footprint.
 - 2. Coordinate with other grounding and bonding systems specified.
 - 3. Provide copper, bronze, or stainless steel components, as applicable; no aluminum.

4. Provide system certified by Underwriters Laboratories or Lightning Protection Institute.

2.03 COMPONENTS

- A. All Components: Complying with applicable requirements of UL 96.
- B. Strike (Air) Terminals: Copper, solid, with adhesive bases for single-ply roof installations.
- C. Grounding Rods: Solid copper.
- D. Ground Plate: Copper.
- E. Conductors: Copper cable.
- F. Connectors and Splicers: Bronze.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated on shop drawings.
- B. Coordinate work with installation of roofing and exterior and interior finishes.

3.02 INSTALLATION

- A. Install in accordance with referenced system standards and as required for specified certification.
- B. Connect conductors using mechanical connectors or exothermic welding process; protect adjacent construction elements and finishes from damage.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 45 16-Field Quality Control Procedures for City of Madison requirements for additional requirements.
- B. Perform visual inspection as specified in NFPA 780 as if this were a periodic follow-up inspection.
- C. Perform continuity testing as specified in NFPA 780 as if this were testing for periodic maintenance.
- D. Obtain services of specified certification agency to provide inspection and certification of lightning protection system, including performance of other testing required by that agency.

END OF SECTION

**SECTION 21 05 00
COMMON WORK RESULTS FOR FIRE SUPPRESSION**

GENERAL

1.01 SECTION INCLUDES

- A. Escutcheons.
- B. Pipe hangers and supports.

1.02 RELATED REQUIREMENTS

- A. Section 21 13 00 - Fire-Suppression Sprinkler Systems: Sprinkler systems design.

1.03 REFERENCE STANDARDS

- A. ASME A112.18.1 - Plumbing Supply Fittings 2018, with Errata.
- B. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators 2023.
- C. NFPA 13 - Standard for the Installation of Sprinkler Systems Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide manufacturer's catalog information. Indicate valve data and ratings.
- C. Shop Drawings: Indicate pipe materials used, jointing methods, supports, and floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
- D. Project Record Documents: Record actual locations of components and tag numbering.
- E. Operation and Maintenance Data: Include installation instructions and spare parts lists.
- F. Extra Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements for City of Madison additional provisions.
 - 2. Extra Valve Stem Packings: Two for each type and size of valve.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section.
 - 1. Minimum five years experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.07 WARRANTY

- A. See Section 01 77 00 - Closeout Submittals for City of Madison additional warranty requirements.

PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Sprinkler-based System:
 - 1. Comply with NFPA 13.

2. See Section 21 13 00.
- B. Welding Materials and Procedures: Comply with ASME BPVC-IX.
- C. Provide system pipes, fittings, sleeves, escutcheons, seals, and other related accessories.

2.02 ESCUTCHEONS

- A. Material:
 1. Fabricate from nonferrous metal.
 2. Chrome-plated.
 3. Metals and Finish: Comply with ASME A112.18.1.
- B. Construction:
 1. One-piece for mounting on chrome-plated tubing or pipe and one-piece or split-pattern type elsewhere.
 2. Internal spring tension devices or setscrews to maintain a fixed position against a surface.

2.03 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
- B. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
- C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

EXECUTION

3.01 INSTALLATION

- A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.
- B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- C. Install piping to conserve building space, to not interfere with use of space and other work.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Pipe Hangers and Supports:
 1. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 2. Place hangers within 12 inches of each horizontal elbow.
 3. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- G. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- H. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.
- I. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
- J. Escutcheons:
 1. Install and firmly attach escutcheons at piping penetrations into finished spaces.
 2. Provide escutcheons on both sides of partitions separating finished areas through which piping passes.

- 3. Use chrome plated escutcheons in occupied spaces and to conceal openings in construction.
- K. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.

3.02 CLEANING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION

SECTION 21 05 23
GENERAL-DUTY VALVES FOR WATER-BASED FIRE SUPPRESSION PIPING

GENERAL

1.01 SECTION INCLUDES

- A. Two-piece ball valves with indicators.
- B. Bronze butterfly valves with indicators.
- C. Iron butterfly valves with indicators.
- D. Check valves.
- E. Bronze OS&Y gate valves.
- F. Iron OS&Y gate valves.
- G. NRS gate valves.
- H. Indicator posts.
- I. Trim and drain valves.

1.02 RELATED REQUIREMENTS

- A. Section 21 05 53 - Identification for Fire Suppression Piping and Equipment.
- B. Section 21 13 00 - Fire-Suppression Sprinkler Systems.

1.03 REFERENCE STANDARDS

- A. FM (AG) - FM Approval Guide Current Edition.
- B. NFPA 13 - Standard for the Installation of Sprinkler Systems Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. NFPA 13R - Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies 2022, with Errata.
- D. UL (DIR) - Online Certifications Directory Current Edition.
- E. UL 262 - Gate Valves for Fire-Protection Service Current Edition, Including All Revisions.
- F. UL 312 - Check Valves for Fire-Protection Service Current Edition, Including All Revisions.
- G. UL 1091 - Standard for Butterfly Valves for Fire-Protection Service Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Obtain valves for each valve type from single manufacturer.

PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. UL Listed: Provide valves listed in UL (DIR) under following headings and bearing UL mark:
-

1. Main Level: HAMV - Fire Main Equipment.
 - a. Level 1: HCBZ - Indicator Posts, Gate Valve.
 - b. Level 1: HLOT - Valves.
 - c. Level 3: HLUG - Ball Valves, System Control.
 - d. Level 3: HLXS - Butterfly Valves.
 - e. Level 3: HMER - Check Valves.
 - f. Level 3: HMRZ - Gate Valves.
2. Main Level: VDGT - Sprinkler System & Water Spray System Devices.
 - a. Level 1: VQGU - Valves, Trim, and Drain.

B. ASME Compliance:

C. Comply with NFPA 13 and NFPA 13R for valves.

D. Valve Pressure Ratings: Not less than minimum pressure rating indicated or higher as required.

E. Valve Sizes: Same as upstream piping unless otherwise indicated.

2.02 TWO-PIECE BALL VALVES WITH INDICATORS

A. Description:

1. Minimum Pressure Rating: 175 psig.
2. Body Design: Two piece.
3. Body Material: Forged brass or bronze.
4. Port Size: Full or standard.
5. Seat: PTFE.
6. Stem: Bronze or stainless steel.
7. Ball: Chrome-plated brass.
8. Actuator: Worm gear or traveling nut.

2.03 BRONZE BUTTERFLY VALVES WITH INDICATORS

- A. UL 1091 and FM (AG) standard listing for indicating valves, (butterfly or ball type), Class Number 1112.
- B. Minimum Pressure Rating: 175 psig.
- C. Body Material: Bronze.
- D. Seat: EPDM.
- E. Stem: Bronze or stainless steel.
- F. Disc: Bronze with EPDM coating.
- G. Actuator: Worm gear or traveling nut.
- H. Supervisory Switch: Internal or external.

2.04 IRON BUTTERFLY VALVES WITH INDICATORS

- A. UL 1091 and FM (AG) standard listing for indicating valves (butterfly or ball type), Class Number 112.
- B. Minimum Pressure Rating: 175 psig.
- C. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.
- D. Seat: EPDM.
- E. Stem: Stainless steel.
- F. Disc: Ductile iron, nickel plated.
- G. Actuator: Worm gear or traveling nut.
- H. Supervisory Switch: Internal or external.
- I. Body Design: Grooved-end connections.

2.05 CHECK VALVES

- A. UL 312 and FM (AG) standard listing for check valves, Class Number 1045.
- B. Minimum Pressure Rating: 175 psig.
- C. Type: Center guided check valve.
- D. Body Material: Cast iron, ductile iron.
- E. Center guided check with elastomeric seal.
- F. Hinge Spring: Stainless steel.
- G. End Connections: Flanged, grooved, or threaded.

2.06 BRONZE OS&Y GATE VALVES

- A. UL 262 and FM (AG) standard listing for fire-service water control valves (OS&Y and NRS-type gate valves).
- B. Minimum Pressure Rating: 175 psig.
- C. Body and Bonnet Material: Bronze or brass.
- D. Wedge: One-piece bronze or brass.
- E. Wedge Seat: Bronze.
- F. Stem: Bronze or brass.
- G. Packing: Non-asbestos PTFE.
- H. Supervisory Switch: External.
- I. End Connections: Threaded.

2.07 IRON OS&Y GATE VALVES

- A. Maximum Working Pressure: 175 psi.
- B. Body and Bonnet Material: Cast or ductile iron.
- C. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
- D. Stem: Brass, bronze, or stainless steel.
- E. Packing: Non-asbestos PTFE.
- F. Supervisory Switch: External.

2.08 NRS GATE VALVES

- A. UL 262 and FM (AG) standard listing for fire-service water control valves (OS&Y and NRS-type gate valves).
- B. Minimum Pressure Rating: 175 psig.
- C. Body and Bonnet Material: Cast or ductile iron.
- D. Wedge: Cast or ductile iron with elastomeric coating.
- E. Stem: Brass or bronze.
- F. Packing: Non-asbestos PTFE.
- G. Supervisory Switch: External.
- H. End Connections: Flanged.

2.09 INDICATOR POSTS

- A. Type: Underground.
 - B. Base Barrel Material: Cast or ductile iron.
-

- C. Cap: Cast or ductile iron.
- D. Operation: Wrench.

2.10 TRIM AND DRAIN VALVES

- A. Ball Valves:
 - 1. Description:
 - a. Pressure Rating: 175 psig.
 - b. Body Design: Two piece.
 - c. Body Material: Forged brass or bronze.
 - d. Port Size: Full or standard.
 - e. Seat: PTFE.
 - f. Stem: Bronze or stainless steel.
 - g. Ball: Chrome-plated brass.
 - h. Actuator: Hand-lever.
- B. Angle Valves:
 - 1. Description:
 - a. Pressure Rating: 175 psig.
 - b. Body Material: Brass or bronze.
 - c. Ends: Threaded.
 - d. Stem: Bronze.
 - e. Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.
- C. Globe Valves:
 - 1. Description:
 - a. Pressure Rating: 175 psig.
 - b. Body Material: Bronze with integral seat and screw-in bonnet.
 - c. Ends: Threaded.
 - d. Stem: Bronze.
 - e. Disc Holder and Nut: Bronze.
 - f. Disc Seat: Nitrile.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

EXECUTION

3.01 EXAMINATION

- A. Confirm valve interior to be free of foreign matter and corrosion.
- B. Remove packing materials.
- C. Examine guides and seats by operating valves from the fully open position to the fully closed position.
- D. Examine valve threads and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage.
 - 1. Check bolting for proper size, length, and material.
 - 2. Verify gasket for size, defects, damage, and suitable material composition for service.
 - 3. Replace all defective valves with new valves.

3.02 INSTALLATION

- A. Comply with specific valve installation requirements and application in the following Sections:
 - 1. Section 21 13 00 for application of valves in wet and dry pipe, fire-suppression sprinkler systems.

- B. Install listed fire protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections.
 - 1. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Valves in horizontal piping installed with stem at or above the pipe center.
- D. Position valves to allow full stem movement.
- E. Install valve tags. Comply with Section 21 05 53 requirements for valve tags, schedules, and signs on surfaces concealing valves; and the appropriate NFPA standard applying to the piping system in which valves are installed.

END OF SECTION

SECTION 21 05 53
IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

GENERAL

1.01 SECTION INCLUDES

- A. Tags.
- B. Pipe markers.

1.02 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems 2023.

1.03 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and installation instructions.
- F. Project Record Documents: Record actual locations of tagged valves.

PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Piping 3/4 inch diameter and larger: Pipe markers.
- B. Piping 3/4 inch diameter and smaller: Tags.

2.02 TAGS

- A. Manufacturers:
 - 1. Advanced Graphic Engraving, LLC.
 - 2. Brady Corporation.
 - 3. Brimar Industries, Inc.
 - 4. Craftmark Pipe Markers.
 - 5. Kolbi Pipe Marker Co.
 - 6. Seton Identification Products.
 - 7. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.
- C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.03 PIPE MARKERS

- A. Manufacturers:
 - 1. Brady Corporation.
 - 2. Brimar Industries, Inc.
 - 3. Craftmark Pipe Markers.
 - 4. Kolbi Pipe Marker Co.
 - 5. Panduit.
 - 6. Seton Identification Products.
 - 7. Substitutions: See Section 01 60 00 - Product Requirements.

- B. Color: Comply with ASME A13.1.
- C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
- E. Color code as follows:
 - 1. Fire Quenching Fluids: Red with white letters.

EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

- A. Install tags with corrosion resistant chain.
- B. Install plastic pipe markers in accordance with manufacturer's instructions.
- C. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- D. Use tags on piping 3/4 inch diameter and smaller.
 - 1. Identify service, flow direction, and pressure.
 - 2. Install in clear view and align with axis of piping.
 - 3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

SECTION 21 11 00
FACILITY FIRE SUPPRESSION WATER SERVICE PIPING

GENERAL

1.01 SECTION INCLUDES

- A. Water pipe.

1.02 REFERENCE STANDARDS

- A. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300 2021.
- B. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250 2021.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.
- D. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete 2023.
- E. AWWA M11 - Steel Pipe - A Guide for Design and Installation 2017, with Addendum (2019).

1.03 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data:
 - 1. Include data on pipe materials, pipe fittings, valves, and accessories.
 - 2. Provide manufacturer's catalog information.
 - 3. Indicate valve data and ratings.
 - 4. Show grooved joint couplings, fittings, valves, and specialties on drawings and product submittals, specifically identified with the manufacturer's style or series designation.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years documented experience.
- C. Perform Work in accordance with local authorities having jurisdiction, municipality, and water utility requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.06 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen.

PRODUCTS

2.01 WATER PIPE

- A. Steel Pipe: Standard weight, zinc-coated, listed, ASTM A53/A53M.
 - 1. Fittings: Comply with ASME B16.3 Class 150, zinc-coated, threaded or ASME B16.4 Class 125, zinc-coated.
 - 2. Mechanically Factory Applied Protective Materials:
 - a. Clean by wire brushing and solvent cleaning.

- b. Apply one coat of coal-tar primer and two coats of coal-tar enamel complying with AWWA C203 for underground piping.
- c. Protect threaded pipe ends and fittings prior to coating.

EXECUTION

3.01 EXAMINATION

- A. Verify that building service connection and municipal utility water main size, location, and invert are as indicated.

3.02 PREPARATION

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or unions.

3.03 INSTALLATION

- A. General Requirements:
 - 1. Location of Water Lines:
 - a. Terminate the work covered by this Section at a point approximately 5 feet from the building unless indicated otherwise.
 - b. Do not install water line closer horizontally than 10 feet from any sewer line unless indicated otherwise.
 - 2. Sleeving:
 - a. Provide ductile iron or Schedule 40 steel sleeves.
 - b. Fill annular space between pipe and sleeves with mastic.
 - c. Install water pipe and sleeve without damaging structures or causing settlement or movement of foundations or footings.
 - 3. Pipe Laying and Jointing:
 - a. Remove fins and burrs from pipe and fittings.
 - b. Prior to placing in position, clean pipe, fittings, valves, and accessories, and maintain in clean condition.
 - c. Provide proper facilities for lowering pipe sections into trenches.
 - d. Dropping or dumping of piping, fittings, valves, or any other water line material into trenches is not permitted.
 - e. Cut pipe in a neat, workmanlike manner accurately to length established at the site and work into place without forcing or springing.
 - f. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material.
 - g. Wedging or blocking between bells and spigots will not be permitted.
 - h. Grade the pipeline in straight lines avoiding the formation of dips and low points.
 - i. Support piping at proper elevation and grade.
 - j. Secure firm, uniform support.
 - k. Wood support blocking will not be permitted.
 - l. Install pipe so that the full length of each pipe section and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings.
 - m. Provide anchors and supports where indicated and necessary for fastening work into place.
 - n. Provide proper provisions for expansion and contraction of pipelines.
 - o. Keep trenches free of water until joints have been properly made.
 - p. Close open ends of piping temporarily with wood blocks or bulkheads at the end of each workday.
 - q. Do not install pipe during unacceptable trench conditions or inclement weather.
 - r. Minimum Depth of Pipe Cover: Not less than 6 feet.

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4. Connections to Existing Water Lines:
 - a. Ensure minimal interruption of service on the existing line.
 - b. Make connections to existing lines under pressure in accordance with the recommended procedures of the manufacturer of the pipe being tapped.
 5. Penetrations:
 - a. Provide ductile-iron or Schedule 40 steel for pipes passing through walls of valve pits and structures.
 - b. Fill annular space between sleeves and walls with rich cement mortar.
 - c. Fill annular space between pipe and sleeves with mastic.
- B. Special Requirements:
1. Steel Piping:
 - a. Jointing:
 - 1) Grooved:
 - (a) Make grooved type joints with the couplings specified for this type joint connecting pipe with roll-grooved ends or pipe with welded-on cut-grooved adapters, each with dimensions as previously specified for this type of joint.
 - (b) Groove pipe ends in the field only with approved groove rolling equipment and groove adapters in the field only with approved groove cutting equipment; use only groove rolling and groove cutting equipment designed especially for the purpose and produced by a manufacturer of grooved joint couplings.
 - (c) Obtain approval for field-cut grooves prior to assembling the joint.
 - b. Pipe Anchorage:
 - 1) Provide concrete thrust blocks (reaction backing) for pipe anchorage, except where metal harness is indicated.
 - 2) Thrust blocks to be in accordance with the recommendations for thrust restraint in AWWA M11, except that size and positioning of thrust blocks are to be as indicated.
 - 3) Use ASTM C94/C94M concrete having a minimum compressive strength of 2500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2-1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.
 - 4) Metal Harness:
 - (a) Provide in accordance with the recommendations for joint harnesses in AWWA M11, except as otherwise indicated.
 - (b) Fabricated by the pipe manufacturer and furnished with the pipe.
 - C. Valves:
 1. Set valves on solid bearing.
 2. Center and plumb valve box over valve.
 3. Set box cover flush with finished grade.

3.04 SERVICE CONNECTIONS

- A. Anchor fire service main to interior surface of foundation wall.

3.05 FIELD QUALITY CONTROL

- A. Field Tests and Inspections:
1. See Section 01 45 16 - Field Quality Control Procedures for City of Madison additional requirements.
 2. Provide all labor, equipment, and incidentals required for field testing, except that water and electric power needed for field tests will be furnished as set forth in Section 01 51 00 - Temporary Utilities.
 3. Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently and at least 5 days after placing of concrete.
-

4. Fill pipeline 24 hours before testing and apply test pressure to stabilize system, using only potable water.
5. Pressure test piping to 200 psi.
6. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
7. Prepare reports of testing activities.

3.06 CLOSEOUT ACTIVITIES

- A. Demonstrate proper operation of equipment to Owner's designated representative.

END OF SECTION

SECTION 21 13 00
FIRE SUPPRESSION SPRINKLER SYSTEMS

GENERAL

1.01 SECTION INCLUDES

- A. Wet-pipe sprinkler system.
- B. System design, installation, and certification.
- C. Fire department connections.

1.02 RELATED REQUIREMENTS

- A. Section 21 05 53 - Identification for Fire Suppression Piping and Equipment.

1.03 REFERENCE STANDARDS

- A. ITS (DIR) - Directory of Listed Products Current Edition.
- B. NFPA 13 - Standard for the Installation of Sprinkler Systems Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL (DIR) - Online Certifications Directory Current Edition.
- D. UL 405 - Standard for Safety Fire Department Connection Devices Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene two week before starting work of this section.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
 - B. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
 - C. Shop Drawings:
 - 1. Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation.
 - 2. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components, and accessories. Indicate system controls.
 - 3. Submit shop drawings, product data, and hydraulic calculations to Authorities Having Jurisdiction for approval. Submit proof of approval to Architect.
 - D. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds code requirements.
 - E. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.
 - F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements for City of Madison additional provisions.
 - 2. Extra Sprinklers: Type and size matching those installed in quantity required by referenced NFPA design and installation standard.
 - 3. Sprinkler Wrenches: Provide suitable wrenches for each sprinkler type.
 - G. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.
 - 1. Sprinklers shall be referred to on drawings, submittals, and other documentation, by the sprinkler identification or Model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.
-

1.06 QUALITY ASSURANCE

- A. Maintain two copies of referenced design and installation standard on site.
- B. Comply with NFPA 13 requirements.
- C. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years experience.
- E. Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience.
- F. Equipment and Components: Provide products that bear UL (DIR) label or marking.
- G. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
 - 1. All castings used for couplings housings, fittings, or valve and specialty bodies shall be date stamped for quality assurance and traceability.

1.07 MOCK-UP

- A. Provide components for installation in mock-up.
- B. Mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PRODUCTS**2.01 MANUFACTURERS**

- A. Sprinklers, Valves, and Equipment:
 - 1. Victaulic Company.
 - 2. Tyco Fire Protection Products.
 - 3. Reliable Automatic Sprinkler Company.
 - 4. Viking Corporation.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 SPRINKLER SYSTEM

- A. Sprinkler System: Provide coverage for entire building.
- B. Occupancy: Light hazard; comply with NFPA 13.
- C. Water Supply: Determine volume and pressure from water flow test data.
 - 1. Revise design when test data available prior to submittals.
- D. Interface system with building fire and smoke alarm system.
- E. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to alarm valve.

2.03 SPRINKLERS

- A. Suspended Ceiling Type: Concealed pendant type with matching screw on cover plate.
 - 1. Response Type: Quick.
 - 2. Coverage Type: Extended.
 - 3. Finish: Chrome plated.
 - 4. Escutcheon Plate Finish: Chrome plated.
 - 5. Fusible Link: Glass bulb type temperature rated for specific area hazard.
 - 6. Coupling sprinkler heads may be used in direct substitution where applicable.
 - B. Exposed Area Type: Upright type with guard.
-

1. Response Type: Quick.
 2. Coverage Type: Extended.
 3. Finish: Chrome plated.
 4. Fusible Link: Glass bulb type temperature rated for specific area hazard.
- C. Sidewall Type: Semi-recessed horizontal sidewall type with matching screw on escutcheon plate.
1. Response Type: Quick.
 2. Coverage Type: Extended.
 3. Finish: Chrome plated.
 4. Escutcheon Plate Finish: Chrome plated.
 5. Fusible Link: Glass bulb type temperature rated for specific area hazard.
- D. Escutcheons and Guards shall be listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.
- E. Wrenches shall be provided by the sprinkler manufacturer that directly engage the wrench boss cast in the sprinkler body.
- F. Flexible Drop System: Stainless steel, multiple use, open gate type.
1. Application: Use to properly locate sprinkler heads.
 2. Include all supports and bracing.
 3. Provide braided type 304 stainless steel tube, zinc plated steel male threaded nipple or groove style coupling for connection to branch-line piping, and a zinc plated steel reducer with a female thread for connection to the sprinkler head.
 - a. UL approved with a bend radius to 3".
 4. Manufacturers:
 - a. Anvil International.
 - b. Victaulic Companycom/#sle.
 - c. ARGCO.
 - d. Gateway Tubing.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 PIPING SPECIALTIES

- A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber-faced clapper to automatically actuate water motor alarm, pressure retard chamber and variable pressure trim with the following additional capabilities and features:
1. Activate electric alarm.
 2. Test and drain valve.
 3. Replaceable internal components without removing valve from installed position.
- B. Backflow Preventer: Reduced pressure principle valve assembly backflow preventer with drain and OS & Y gate valve on each end.
- C. Test Connections:
1. Backflow Preventer Test Connection:
 - a. Provide downstream of the backflow prevention assembly, listed hose valves with 2.5 inch National Standard male hose threads with cap and chain.
 - b. Furnish one valve for each 250 gpm of system demand or fraction thereof.
 - c. Provide permanent sign reading "Test Valve" in accordance with Section 21 05 53.
- D. Water Motor Alarm: Hydraulically operated impeller type alarm with aluminum alloy red enameled gong and motor housing, nylon bearings, and inlet strainer.
- E. Electric Alarm: Electrically operated red enameled gong with pressure alarm switch.
- F. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC.
- G. Fire Department Connections:

1. Type: Flush, wall mount made of corrosion resistant metal complying with UL 405.
 - a. Configuration: Horizontal.
 - b. Rated Working Pressure: 175 psi.

EXECUTION

3.01 INSTALLATION

- A. Install in accordance with referenced NFPA design and installation standard.
- B. Install equipment in accordance with manufacturer's instructions.
- C. Locate outside alarm gong on building wall as indicated.
- D. Place pipe runs to minimize obstruction to other work.
- E. Place piping in concealed spaces above finished ceilings.
- F. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.
- G. Flush entire piping system of foreign matter.
- H. Hydrostatically test entire system.
- I. Require test be witnessed by Authority Having Jurisdiction.

3.02 INTERFACE WITH OTHER PRODUCTS

- A. Ensure required devices are installed and connected as required to fire alarm system.

END OF SECTION

SECTION 22 05 13
COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General construction and requirements.
- B. Single phase electric motors.
- C. Three phase electric motors.
- D. Electronically Commutated Motors (ECM).

1.02 RELATED REQUIREMENTS

- A. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings 2015 (Reaffirmed 2020).
- B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators 2017.
- C. NEMA MG 1 - Motors and Generators 2021.
- D. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.

1.05 QUALITY ASSURANCE

- A. Comply with applicable electrical code.
- B. Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the Authority Having Jurisdiction as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.07 WARRANTY

- A. See Section 01 77 00 - Closeout Submittals for City of Madison additional warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Electrical Service: Refer to Section 26 05 83 for required electrical characteristics.
- B. Electrical Service:
 - 1. Motors 3/4 HP and Smaller: 115 volts, single phase, 60 Hz.
 - 2. Motors Larger than 3/4 Horsepower: 480 volts, three phase, 60 Hz.
- C. Construction:
 - 1. Open drip-proof type except where specifically noted otherwise.
 - 2. Design for continuous operation in 104 degrees F environment.
 - 3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

- D. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- E. Wiring Terminations:
 - 1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
 - 2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.02 SINGLE PHASE POWER - SPLIT PHASE MOTORS

- A. Starting Torque: Less than 150 percent of full load torque.
- B. Starting Current: Up to seven times full load current.
- C. Breakdown Torque: Approximately 200 percent of full load torque.
- D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
- E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.03 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

- A. Starting Torque: Exceeding one fourth of full load torque.
- B. Starting Current: Up to six times full load current.
- C. Multiple Speed: Through tapped windings.
- D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.04 SINGLE PHASE POWER - CAPACITOR START MOTORS

- A. Starting Torque: Three times full load torque.
- B. Starting Current: Less than five times full load current.
- C. Pull-up Torque: Up to 350 percent of full load torque.
- D. Breakdown Torque: Approximately 250 percent of full load torque.
- E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
- F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.
- G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.05 THREE PHASE POWER - SQUIRREL CAGE MOTORS

- A. Starting Torque: Between 1 and 1-1/2 times full load torque.
- B. Starting Current: Six times full load current.
- C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
- D. Design, Construction, Testing, and Performance: Comply with NEMA MG 1 for Design B motors.
- E. Insulation System: NEMA Class B or better.
- F. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.

- G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- H. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- I. Nominal Efficiency: As indicated at full load and rated voltage when tested in accordance with IEEE 112.
- J. Nominal Power Factor: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

2.06 ELECTRONICALLY COMMUTATED MOTORS (ECM)

- A. Rotor: Permanent Magnet
- B. Pump Body: Cast Iron
- C. Ambient Temperature Range: 32 degrees F - 104 degrees. F
- D. Synchronous Rotation: All motors shall be designed for synchronous rotation.
- E. Mounting: Motor shall be able to be mounted with shaft in horizontal or vertical orientation.
- F. Efficiency: Motor shall maintain a minimum of 70% efficiency over its entire operating range.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- C. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION

SECTION 22 05 17
SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

GENERAL

1.01 SECTION INCLUDES

- A. Pipe sleeves.
- B. Pipe sleeve-seals.

1.02 RELATED REQUIREMENTS

- A. Section 22 05 23 - General-Duty Valves for Plumbing Piping.
- B. Section 22 05 53 - Identification for Plumbing Piping and Equipment: Piping identification.
- C. Section 22 07 19 - Plumbing Piping Insulation.

1.03 REFERENCE STANDARDS

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type) 2022a.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2023a.
- C. UL (DIR) - Online Certifications Directory Current Edition.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified this section.

PRODUCTS

2.01 PIPE SLEEVES

- A. Pipe Passing Through Below Grade Exterior Walls:
 - 1. Zinc coated or cast iron pipe.
 - 2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.

2.02 PIPE-SLEEVE SEALS

- A. Modular Mechanical Sleeve-Seal:
 - 1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
 - 2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
 - 3. Size and select seal component materials in accordance with service requirements.
 - 4. Glass-reinforced plastic pressure end plates.
- B. Pipe Sleeve Material:
 - 1. Bearing Walls: Steel, cast iron, or terra-cotta pipe.
 - 2. Masonry Structures: Sheet metal or fiber.

EXECUTION

3.01 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.

- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
- E. Manufactured Sleeve-Seal Systems:
 - 1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
 - 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
 - 3. Locate piping in center of sleeve or penetration.
 - 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
 - 5. Tighten bolting for a water-tight seal.
 - 6. Install in accordance with manufacturer's recommendations.
- F. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

END OF SECTION

SECTION 22 05 19
METERS AND GAUGES FOR PLUMBING PIPING

GENERAL

1.01 SECTION INCLUDES

- A. Pressure gauges and pressure gauge taps.
- B. Thermometers and thermometer wells.
- C. Static pressure gauges.

1.02 RELATED REQUIREMENTS

- A. Section 22 05 23 - General Duty Valves for Plumbing Piping.
- B. Section 22 10 05 - Plumbing Piping.
- C. Section 22 30 00 - Plumbing Equipment.

1.03 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments 2022.
- B. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi 2004 (Reaffirmed 2017).
- C. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers 2014 (Reapproved 2020).
- D. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers 2014 (Reapproved 2021).

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Project Record Documents: Record actual locations of components and instrumentation.

1.05 FIELD CONDITIONS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PRODUCTS

2.01 PRESSURE GAUGES

- A. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
 - 1. Case: Steel with brass bourdon tube.
 - 2. Size: 4-1/2 inch diameter.
 - 3. Mid-Scale Accuracy: One percent.

2.02 PRESSURE GAUGE TAPPINGS

- A. Gauge Cock: Tee or lever handle, brass for maximum 150 psi.
- B. Needle Valve: Brass, 1/4 inch NPT for minimum 150 psi.
- C. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections.
- D. Syphon: Steel, Schedule 40, 1/4 inch angle or straight pattern.

2.03 STEM TYPE THERMOMETERS

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc.
 - 2. Omega Engineering, Inc.
 - 3. Weksler Glass Thermometer Corp.
 - 4. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

- B. Thermometers - Fixed Mounting: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish.
 - 1. Size: 9 inch scale.
 - 2. Window: Clear Lexan.
 - 3. Accuracy: 2 percent, per ASTM E77.
- C. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
 - 1. Size: 9 inch scale.
 - 2. Window: Clear Lexan.
 - 3. Stem: 3/4 inch NPT brass.
 - 4. Accuracy: 2 percent, per ASTM E77.
 - 5. Calibration: Degrees F.

2.04 DIAL THERMOMETERS

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc.
 - 2. Omega Engineering, Inc.
 - 3. Weksler Glass Thermometer Corp.
 - 4. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. Thermometers - Fixed Mounting: Dial type bimetallic actuated; ASTM E1; stainless steel case, silicone fluid damping, white with black markings and black pointer, hermetically sealed lens, stainless steel stem.
 - 1. Size: 5 inch diameter dial.
 - 2. Lens: Clear glass.
 - 3. Accuracy: 1 percent.
- C. Thermometers - Adjustable Angle: Dial type bimetallic actuated; ASTM E1; stainless steel case, adjustable angle with front recalibration, silicone fluid damping, white with black markings and black pointer, hermetically sealed lens, stainless steel stem.
 - 1. Lens: Clear glass.
 - 2. Accuracy: 1 percent.
- D. Thermometers: Dial type vapor or liquid actuated; ASTM E1; stainless steel case, with brass or copper bulb, copper or bronze braided capillary, white with black markings and black pointer, glass lens.
 - 1. Size: 4-1/2 inch diameter dial.
 - 2. Lens: Clear glass.
 - 3. Length of Capillary: Minimum 5 feet.
 - 4. Accuracy: 2 percent.

2.05 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
- B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.06 TEST PLUGS

- A. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.

2.07 STATIC PRESSURE GAUGES

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc.

2. Omega Engineering, Inc.
 3. Weksler Glass Thermometer Corp.
 4. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. 3-1/2 inch diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.

EXECUTION**3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install positive displacement meters with isolating valves on inlet and outlet to AWWA M6. Provide full line size valved bypass with globe valve for liquid service meters.
- C. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.
- D. Install pressure gauges with pulsation dampers. Provide gauge cock to isolate each gauge. Extend nipples and siphons to allow clearance from insulation. Provide siphon on gauges in steam systems.
- E. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- F. Coil and conceal excess capillary on remote element instruments.
- G. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- H. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- I. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- J. Locate test plugs adjacent thermometers and thermometer sockets.

END OF SECTION

SECTION 22 05 23
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Applications.
- B. Angle valves.
- C. Ball valves.
- D. Check valves.
- E. Gate valves.
- F. Globe valves.

1.02 RELATED REQUIREMENTS

- A. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
- B. Section 22 10 05 - Plumbing Piping.

1.03 ABBREVIATIONS AND ACRONYMS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Non-rising stem.
- E. OS&Y: Outside screw and yoke.
- F. PTFE: Polytetrafluoroethylene.
- G. RS: Rising stem.
- H. SWP: Steam working pressure.
- I. TFE: Tetrafluoroethylene.
- J. WOG: Water, oil, and gas.

1.04 REFERENCE STANDARDS

- A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch 2013 (Reaffirmed 2018).
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250 2020.
- C. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard 2020.
- D. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves 2022.
- E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2021.
- F. ASME B16.34 - Valves — Flanged, Threaded, and Welding End 2020.
- G. ASME B31.9 - Building Services Piping 2020.
- H. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings 2017.
- I. AWWA C606 - Grooved and Shouldered Joints 2022.
- J. MSS SP-45 - Drain and Bypass Connections 2020.
- K. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends 2011.
- L. MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends 2011.
- M. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves 2019.

- N. MSS SP-85 - Gray Iron Globe and Angle Valves, Flanged and Threaded Ends 2011.
- O. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends 2010, with Errata .
- P. NSF 61 - Drinking Water System Components - Health Effects 2022, with Errata.
- Q. NSF 372 - Drinking Water System Components - Lead Content 2022.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.06 QUALITY ASSURANCE

- A. Manufacturer:
 - 1. Obtain valves for each valve type from single manufacturer.
 - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
 - 2. Protect valve parts exposed to piped medium against rust and corrosion.
 - 3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
 - 4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
 - 5. Secure check valves in either the closed position or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection and protect flanges and specialties from dirt.
 - a. Provide temporary inlet and outlet caps.
 - b. Maintain caps in place until installation.
 - 2. Store valves in shipping containers and maintain in place until installation.
 - a. Store valves off the ground in watertight enclosures when indoor storage is not an option.

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. See drawings for specific valve locations.
- B. Provide the following valves for the applications if not indicated on drawings:
 - 1. Shutoff: Ball, butterfly, gate or plug.
 - 2. Dead-End: Single-flange butterfly (lug) type.
 - 3. Throttling: Provide globe, angle, ball, or butterfly.
 - 4. Swing Check (Pump Outlet):
 - a. 2 NPS and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. 2-1/2 NPS and Larger for Domestic Water: Iron swing check valves with closure control, metal or resilient seat check valves.
- C. Substitutions of valves with higher CWP classes or SWP ratings for same valve types are permitted when specified CWP ratings or SWP classes are not available.
- D. Required Valve End Connections for Non-Wafer Types:
 - 1. Steel Pipe:
 - a. 2 NPS and Smaller: Threaded ends.

- b. 2-1/2 NPS to 4 NPS: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - c. 5 NPS and Larger: Grooved or flanged ends.
 - 2. Copper Tube:
 - a. 2 NPS and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - b. 2-1/2 NPS to 4 NPS: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
- E. Domestic, Hot and Cold Water Valves:
 - 1. 2 NPS and Smaller:
 - a. Bronze: Provide with solder-joint ends.
 - b. Bronze Angle: Class 125, bronze disc.
 - c. Ball: One piece, full port, brass with brass trim.
 - d. Bronze Swing Check: Class 125, bronze disc.
 - e. Bronze Gate: Class 125, NRS.
 - f. Bronze Globe: Class 125, bronze disc.
 - 2. 2-1/2 NPS and Larger:
 - a. Iron, 2-1/2 NPS to 4 NPS: Provide with threaded ends.
 - b. Iron Ball: Class 150.
 - c. Iron Single-Flange Butterfly: 200 CWP, EPDM seat, aluminum-bronze disc.
 - d. Iron Grooved-End Butterfly: 175 CWP.
 - e. Iron Swing Check: Class 125, metal seats.
 - f. Iron Swing Check with Closure Control: Class 125, lever and spring.
 - g. Iron Grooved-End Swing Check: 300 CWP.
 - h. Iron Center-Guided Check: Class 125, compact-wafer, metal seat.
 - i. Iron Plate-Type Check: Class 125; single plate; metal seat.
 - j. Iron Gate: Class 125, NRS.
 - k. Iron Globe: Class 125.

2.02 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
 - 1. Handwheel: Valves other than quarter-turn types.
 - 2. Hand Lever: Quarter-turn valves 6 NPS and smaller except plug valves.
- D. Valves in Insulated Piping: With 2 NPS stem extensions and the following features:
 - 1. Gate Valves: Rising stem.
 - 2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: Extended neck.
 - 4. Memory Stops: Fully adjustable after insulation is installed.
- E. Valve-End Connections:
 - 1. Threaded End Valves: ASME B1.20.1.
 - 2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
 - 3. Pipe Flanges and Flanged Fittings 1/2 NPS through 24 NPS: ASME B16.5.
 - 4. Solder Joint Connections: ASME B16.18.
 - 5. Grooved End Connections: AWWA C606.
- F. General ASME Compliance:

1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
 2. Solder-joint Connections: ASME B16.18.
 3. Building Services Piping Valves: ASME B31.9.
- G. Potable Water Use:
1. Certified: Approved for use in compliance with NSF 61 and NSF 372.
 2. Lead-Free Certified: Wetted surface material includes less than 0.25 percent lead content.
- H. Valve Bypass and Drain Connections: MSS SP-45.
- I. Source Limitations: Obtain each valve type from a single manufacturer.

2.03 BRONZE, ANGLE VALVES

- A. Class 125: CWP Rating: 200 psig.
1. Comply with MSS SP-80, Type 1.
 2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
 3. Ends: Threaded.
 4. Stem: Bronze.
 5. Disc: Bronze.
 6. Packing: Asbestos free.
 7. Handwheel: Bronze or aluminum.

2.04 BRONZE, BALL VALVES

- A. General:
1. Fabricate from dezincification resistant material.
 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. One Piece, Reduced Port with Bronze Trim:
1. Comply with MSS SP-110.
 2. SWP Rating: 400 psig.
 3. CWP Rating: 600 psig.
 4. Body: Bronze.
 5. Ends: Press.
 6. Seats: PTFE.

2.05 BRONZE, SWING CHECK VALVES

- A. General:
1. Fabricate from dezincification resistant material.
 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Class 125 CWP Rating; 200 psig (1,380 kPa) WOG:
1. Comply with MSS SP-80, Type 3.
 2. Design: Y-pattern, horizontal or vertical flow.
 3. Body: Bronze, ASTM B62.
 4. Ends: Threaded.
 5. Disc: Bronze.

2.06 BRONZE, GATE VALVES

- A. General:
1. Fabricate from dezincification resistant material.
 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. NRS (Non-rising Stem) or OS & Y (Rising Stem):
1. Comply with MSS SP-80, Type I.
 2. Class 125: CWP Rating 200 psig.
 3. Body: ASTM B62, bronze with integral seat and screw-in bonnet.

4. Ends: Threaded or solder joint joint.
5. Stem: Bronze.
6. Disc: Solid wedge; bronze.
7. Packing: Asbestos free.
8. Handwheel: Malleable iron, bronze, or aluminum.

2.07 BRONZE, GLOBE VALVES

- A. General:
 1. Fabricate from dezincification resistant material.
 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Class 125: CWP Rating 200 psig:
 1. Comply with MSS SP-80, Type 1.
 2. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
 3. Ends: Threaded joint.
 4. Stem: Bronze.
 5. Disc: PTFE.
 6. Packing: Asbestos free.
 7. Handwheel: Malleable Iron.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- D. Install check valves where necessary to maintain direction of flow as follows:
 1. Lift Check: Install with stem plumb and vertical.
 2. Swing Check: Install horizontal maintaining hinge pin level.
- E. Provide chainwheels on operators for valves 4 NPS and larger where located 96 NPS or more above finished floor, terminating 60 NPS above finished floor.

END OF SECTION

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

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe hangers.
- B. Pipe supports, guides, shields, and saddles.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2023.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping 2023.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings 1999, with Editorial Revision (2022).
- F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates 2018.
- G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures 1999 (Reapproved 2022).
- H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2023.
- I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2023.
- J. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2023.
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023c.
- L. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a, with Editorial Revision (2023).
- M. FM (AG) - FM Approval Guide Current Edition.
- N. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).
- O. UL (DIR) - Online Certifications Directory Current Edition.
- P. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.04 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 of any conflicts with or deviations from 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 in accordance with Section 03 30 00.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
- C. Manufacturer's 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.

1.06 QUALITY ASSURANCE

- A. Comply with latest requirements of ANSI Code for building piping and applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Provide required hardware to hang or support piping, equipment, or fixtures with related accessories as necessary to complete installation of plumbing work.
- B. Provide hardware products listed, classified, and labeled as suitable for intended purpose.
- C. 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. Include consideration for vibration, equipment operation, and shock loads where applicable.
- D. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
- E. Materials for Metal Fabricated Supports:
1. Zinc-Plated Steel: Electroplated in accordance with ASTM B633 unless stated otherwise.
 2. Galvanized Steel: Hot-dip galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M unless stated otherwise.
- F. Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.

2.02 PIPE HANGERS

- A. Swivel Ring Hangers, Adjustable:
1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation.
 - b. Anvil, an ASC Engineered Solution.
 - c. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

- d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. Pipe Sizes: For use with pipes 1/2-inch through 2-inch.
 3. MSS SP-58 type 10, epoxy-painted, zinc-colored.
 4. Material: ASTM A36/A36M carbon steel.
 5. FM (AG) and UL (DIR) listed for specific pipe size runs and loads.
- B. Clevis Hangers, Adjustable:
1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation.
 - b. Anvil, an ASC Engineered Solution.
 - c. Hilti.
 - d. Piping Technology & Products, Inc.
 - e. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
 - f. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. Pipe Sizes: For use with pipe sizes 1/2-inch and larger.
 3. Copper Tube: MSS SP-58 type 1, epoxy-plated copper.
 4. Standard-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.

2.03 PIPE SUPPORTS, GUIDES, SHIELDS, AND SADDLES

- A. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- B. Pipe Shields for Insulated Piping:
1. MSS SP-58 type 40, ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
 2. General Construction and Requirements:
 - a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
 - b. Shields Material: PVC.
 - c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
 - d. Service Temperature: Minus 40 to 178 degrees F.
 - e. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
- C. Pipe Supports:
1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
 2. Liquid Temperatures Up to 122 degrees F:
 - a. Overhead Support: MSS SP-58 types 1, 3 through 12 clamps.
 - b. Support From Below: MSS SP-58 types 35 through 38.
- D. Pipe Supports, Thermal Insulated:
1. General Requirements:
 - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
 - b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
 - c. Provide pipe supports for 1/2 to 30 inch iron pipes.
 - d. Insulation inserts to consist of rigid phenolic foam insulation surrounded by 360 degree, PVC jacketing.
 2. PVC Jacket:
 - a. Pipe insulation protection shields to be provided with ball bearing hinge and locking seam.
 - b. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
 - c. Minimum Thickness: 60 mil, 0.06 inch.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- 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.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- C. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- D. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- F. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- G. 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. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- H. Secure fasteners according to manufacturer's recommended torque settings.
- I. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

- A. Inspect support and attachment components for damage and defects.
- 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 support and attachment components.

END OF SECTION

SECTION 22 05 53
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe markers.

1.02 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems 2023.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials 2017.

1.03 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Schedules:
 - 1. Submit plumbing component identification schedule listing equipment, piping, and valves.
 - 2. Detail proposed component identification data in terms of wording, symbols, letter size, and color coding to be applied to corresponding product.
 - 3. Valve Data Format: Include id-number, location, function, and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Samples: Submit two tags, labels, pipe markers, and size used on project.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 PLUMBING COMPONENT IDENTIFICATION GUIDELINE

- A. Nameplates:
 - 1. Water heaters and other heat transfer products.
 - 2. Pumps, Tanks, and other plumbing equipment products.
- B. Tags:
 - 1. Piping: 3/4 inch diameter and smaller.
 - 2. Manual operated and automated control valves.
- C. Pipe Markers: 3/4 inch diameter and higher.

2.02 NAMEPLATES

- A. Manufacturers:
 - 1. Brady Corporation.
 - 2. Brimar Industries, Inc.
 - 3. Craftmark Identification Systems.
 - 4. Kolbi Pipe Marker Co.
 - 5. Panduit.
 - 6. Seton Identification Products.
 - 7. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. Description: Laminated piece with up to three lines of text.
 - 1. Letter Color: Black.
 - 2. Letter Height: 1/4 inch.
 - 3. Background Color: White.

4. Nameplate Material:
 - a. Flexible: Vinyl with adhesive backing per ASTM D709.
 - b. Metal: Brass with center-side holes for screw fastening.

2.03 TAGS

- A. Manufacturers:
 1. Advanced Graphic Engraving.
 2. Brady Corporation.
 3. Brimar Industries, Inc.
 4. Craftmark Pipe Markers.
 5. Kolbi Pipe Marker Co.
 6. Seton Identification Products.
 7. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. Flexible: Vinyl with engraved black letters on light contrasting background color with up to three lines of text. Minimum tag size 1-1/2 inch in diameter.
- C. Metal: Brass, 19 gauge 1-1/2 inch in diameter with smooth edges, stamped, smooth edges, and corrosion-resistant ball chain. Up to three lines of text.
- D. Valve Tag Chart: Typewritten 12-point letter size list of applied tags and location plastic laminated.
- E. Piping: 3/4 inch diameter and smaller. Include corrosion resistant chain. Identify service, flow direction, and pressure.

2.04 PIPE MARKERS

- A. Manufacturers:
 1. Brady Corporation.
 2. Brimar Industries, Inc.
 3. Craftmark Pipe Markers.
 4. Kolbi Pipe Marker Co.
 5. Panduit.
 6. Seton Identification Products.
 7. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. Comply with ASME A13.1.
- C. Flexible Marker: Factory fabricated, semi-rigid, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid conveyed.
- D. Flexible Tape Marker: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
- E. Identification Scheme, ASME A13.1:
 1. Primary: External Pipe Diameter, Uninsulated or Insulated.
 2. Secondary: Color scheme per fluid service.
 - a. Water; Potable, Cooling, Boiler Feed, and Other: White text on green background.
 3. Tertiary: Other Details.
 - a. Directional flow arrow.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive identification products.

3.02 INSTALLATION

- A. Install flexible nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

- B. Install tags in clear view and align with axis of piping.
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install plastic tape pipe marker around pipe in accordance with manufacturer's instructions.
- E. Apply ASME A13.1 Pipe Marking Rules:
 - 1. Place pipe marker adjacent to changes in direction.
 - 2. Place pipe marker adjacent each valve port and flange end.
 - 3. Place pipe marker at both sides of floor and wall penetrations.
 - 4. Place pipe marker every 25 to 50 feet interval of straight run.

END OF SECTION

**SECTION 22 07 19
PLUMBING PIPING INSULATION**

GENERAL

1.01 SECTION INCLUDES

- A. Glass fiber insulation.

1.02 RELATED REQUIREMENTS

- A. Section 22 10 05 - Plumbing Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

- A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus 2019, with Editorial Revision (2023).
- B. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation 2022a.
- C. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel 2008 (Reapproved 2023).
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023c.
- E. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a, with Editorial Revision (2023).
- F. MICA Manual - North American Commercial & Industrial Insulation Standards Manual 9th Edition.
- G. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER INSULATION

- A. Manufacturers:
 - 1. Armstrong International.
 - 2. CertainTeed Corporation.
 - 3. Johns Manville Corporation.
 - 4. Knauf Insulation.
 - 5. Owens Corning Corporation.
 - 6. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible, with wicking material to transport condensed water to the outside of the system for evaporation to the atmosphere.
 - 1. K Value: ASTM C177, 0.23 at 75 degrees F.
 - 2. Maximum Service Temperature: 450 degrees F.
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
 - 1. K Value: ASTM C177, 0.24 at 75 degrees F.
 - 2. Maximum Service Temperature: 450 degrees F.
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- D. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm.
- E. Vapor Barrier Lap Adhesive: Compatible with insulation.

EXECUTION**3.01 INSTALLATION**

- A. Install in accordance with current edition of MICA Manual and manufacturer's installation instructions.
- B. Exposed Piping: Locate insulation and cover seams in least visible locations.
- C. Glass fiber insulated pipes conveying fluids below ambient temperature:
 - 1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- D. Glass fiber insulated pipes conveying fluids above ambient temperature:
 - 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- E. Inserts and Shields:
 - 1. Application: Piping 1-1/2 inches diameter or larger.
 - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.

END OF SECTION

**SECTION 22 10 05
PLUMBING PIPING****GENERAL****1.01 SECTION INCLUDES**

- A. Sanitary waste piping, buried within 5 feet of building.
- B. Sanitary waste piping, above grade.
- C. Domestic water piping, buried within 5 feet of building.
- D. Domestic water piping, above grade.
- E. Storm drainage piping, buried within 5 feet of building.
- F. Storm drainage piping, above grade.

1.02 RELATED REQUIREMENTS

- A. Division 22 - Plumbing.

1.03 REFERENCE STANDARDS

- A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2021.
- B. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings 2021.
- C. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings: DWV 2021.
- D. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings—DWV 2022.
- E. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators 2023.
- F. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings 2021.
- G. ASTM B32 - Standard Specification for Solder Metal 2020.
- H. ASTM B88 - Standard Specification for Seamless Copper Water Tube 2022.
- I. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric) 2020.
- J. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV) 2020.
- K. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube 2016.
- L. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings 2016.
- M. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings 2020a.
- N. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 2021a.
- O. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series) 2020.
- P. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40 2023.
- Q. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems 2020.
- R. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings 2020.

- S. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets 2020.
- T. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings 2023.
- U. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023c.
- V. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings 2023.
- W. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast 2017, with Errata (2018).
- X. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications 2021.
- Y. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications 2020.
- Z. NSF 61 - Drinking Water System Components - Health Effects 2022, with Errata.
- AA. NSF 372 - Drinking Water System Components - Lead Content 2022.
- BB. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
- D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
- E. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.
- B. Plenum-Installed Piping: Flame-spread index equal or below 25 and smoke-spread index equal or below 50 according to ASTM E84 or UL 723 tests.

2.02 SANITARY WASTE AND VENT PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Pipe: ASTM A74 service weight.
 - 1. Fittings: Cast iron.

2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets.
- B. Cast Iron Pipe: CISPI 301, hubless.
 1. Fittings: Cast iron.
 2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.
- C. PVC Pipe: ASTM D2665 or ASTM D3034.
 1. Fittings: PVC.
 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.03 SANITARY WASTE AND VENT WASTE PIPING, ABOVE GRADE

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
 1. Fittings: Cast iron.
 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
- B. PVC Pipe: ASTM D1785 Schedule 40, or ASTM D2241 SDR 26 with not less than 150 psi pressure rating.
 1. Fittings: ASTM D2466, PVC.
 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.04 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. 2-1/2" and Smaller: Copper Pipe: ASTM B88 (ASTM B88M), Type K (A), Drawn (H).
 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 2. Joints: ASTM B32, alloy Sn95 solder.
 3. Mechanical Press Sealed Fittings: Double-pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, nontoxic, synthetic rubber sealing elements.
- B. 3" and Larger: Ductile Iron Pipe: AWWA C151/A21.51.
 1. Fittings: Ductile or gray iron, standard thickness.
 2. Joints: AWWA C111/A21.11, styrene butadiene rubber (SBR) or vulcanized SBR gasket with 3/4 inch diameter rods.

2.05 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 2. Joints: ASTM B32, alloy Sn95 solder.
 3. Mechanical Press Sealed Fittings: Double-pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, nontoxic, synthetic rubber sealing elements.

2.06 STORM DRAINAGE PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Pipe: ASTM A74 extra heavy weight.
 1. Fittings: Cast iron.
 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless, service weight.
 1. Fittings: Cast iron.
 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
- C. PVC Pipe: ASTM D2665 or ASTM D3034.
 1. Fittings: PVC.
 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.07 STORM DRAINAGE PIPING, ABOVE GRADE

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
 1. Fittings: Cast iron.
 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
- B. Copper Tube: ASTM B306, DWV.

1. Fittings: ASME B16.23, cast copper, or ASME B16.29, wrought copper.
 2. Joints: ASTM B32, alloy Sn50 solder.
- C. PVC Pipe: ASTM D2665.
1. Fittings: PVC.
 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

EXECUTION**3.01 PREPARATION**

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- H. Provide access where valves and fittings are not exposed.
- I. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
- J. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

3.03 APPLICATION

- A. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.

END OF SECTION

**SECTION 22 10 06
PLUMBING PIPING SPECIALTIES**

GENERAL

1.01 SECTION INCLUDES

- A. Cleanouts.
- B. Hydrants.
- C. Refrigerator valve and recessed box.

1.02 RELATED REQUIREMENTS

- A. Section 22 10 05 - Plumbing Piping.
- B. Section 22 30 00 - Plumbing Equipment.
- C. Section 22 40 00 - Plumbing Fixtures.

1.03 REFERENCE STANDARDS

- A. ASME A112.6.3 - Floor Drains 2022.
- B. NSF 61 - Drinking Water System Components - Health Effects 2022, with Errata.
- C. NSF 372 - Drinking Water System Components - Lead Content 2022.
- D. PDI-WH 201 - Water Hammer Arresters 2017.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures
- B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept specialties on site in original factory packaging. Inspect for damage.

PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.02 DRAINS

- A. Manufacturers:
 - 1. Jay R. Smith Manufacturing Company.
 - 2. Josam Company.
 - 3. Zurn Industries, LLC.
 - 4. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. Roof Drains:
 - 1. Body: Lacquered cast iron with sump.
 - 2. Strainer: Removable polyethylene or cast iron dome with vandal proof screws.
 - 3. Manufacturers:
 - a. Jay R. Smith Manufacturing Company.
 - b. MIFAB, Inc.
 - c. Zurn Industries, LLC.
 - d. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

C. Floor Drains:

1. Manufacturers:

- a. Jay R. Smith Manufacturing Company.
- b. MIFAB, Inc.
- c. Zurn Industries, LLC.
- d. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

D. Floor Drain (FD-1):

1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.

2.03 CLEANOUTS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company.
2. Josam Company.
3. Zurn Industries, LLC.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Cleanouts at Interior Finished Floor Areas:

1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.

2.04 HYDRANTS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company.
2. Zurn Industries, LLC.
3. Woodford Manufacturing.
4. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

B. Wall Hydrants:

1. ASSE 1019; freeze resistant, self-draining type with chrome plated wall plate hose thread spout, lockshield and removable key, and integral vacuum breaker.

C. Roof Hydrants:

1. ASME A112.21.3M; nonfreeze, exposed-outlet roof hydrant with coated cast-iron head and lift handle with lock option. Provide with deck flange and under deck clamp.
2. Nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.

2.05 WASHING MACHINE BOXES AND VALVES

A. Box Manufacturers:

1. IPS Corporation/Water-Tite.
2. Oatey Supply Chain Services, Inc.
3. Viega LLC: www.viega.us/#sle.
4. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

B. Valve Manufacturers:

1. Viega LLC.
2. Zurn Industries, LLC.
3. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

C. Description: Plastic preformed rough-in box with brass long shank valves with wheel handles, socket for 2 inch waste, slip in finishing cover.

2.06 REFRIGERATOR VALVE AND RECESSED BOX

A. Box Manufacturers:

1. IPS Corporation/Water-Tite.
 2. Oatey Supply Chain Services, Inc.
 3. Viega LLC.
 4. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. Valve Manufacturers:
1. IPS Corporation/Water-Tite.
 2. Viega LLC.
 3. Zurn Industries, LLC.
 4. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- C. Description: Plastic preformed rough-in box with brass valves with wheel handle, slip in finishing cover.

2.07 WATER HAMMER ARRESTORS

- A. Manufacturers:
1. Cash Acme, a brand of Reliance Worldwide Corporation.
 2. Jay R. Smith Manufacturing Company.
 3. Watts Regulator Company, a part of Watts Water Technologies.
 4. Zurn Industries, LLC.
 5. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. Water Hammer Arrestors:
1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F and maximum 250 psi working pressure.

EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Install floor cleanouts at elevation to accommodate finished floor.
- D. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.
- E. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatory sinks or wall outlet boxes.

END OF SECTION

**SECTION 22 30 00
PLUMBING EQUIPMENT**

GENERAL

1.01 SECTION INCLUDES

- A. Hybrid electric heat pump water heaters.
- B. Diaphragm-type compression tanks.
- C. In-line circulator pumps.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Current Edition.
- B. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels 2023.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data:
 - 1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
 - 2. Indicate pump type, capacity, power requirements.
 - 3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
 - 4. Provide electrical characteristics and connection requirements.
- C. Project Record Documents: Record actual locations of components.
- D. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements for City of Madison additional provisions.
 - 2. Extra Pump Seals: One of each type and size.
 - 3. Extra Water Softener Salt: 50 pounds.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Certifications:
 - 1. Gas Water Heaters: AHRI Directory of Certified Product Performance.

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

1.07 DELIVERY, STORAGE, AND HANDLING

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

1.08 WARRANTY

- A. See Section 01 77 00 - Closeout Submittals for City of Madison additional warranty requirements.
- B. Provide five year manufacturer warranty for domestic water heaters.

PRODUCTS

2.01 WATER HEATERS

- A. Manufacturers:
 1. A.O. Smith Water Products Co: www.hotwater.com/#sle.
 2. Bock Water Heaters, Inc: www.rockwaterheaters.com/#sle.
 3. Rheem Manufacturing Company: www.rheem.com/#sle.
 4. Lochinvar, LLC; <https://www.lochinvar.com/products/water-heaters/>.
 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Hybrid Electric Heat Pump Water Heaters:
 1. Type: Automatic, Hybrid Electric / Heat Pump, vertical storage.
 2. Minimum Efficiency Required: ASHRAE Std 90.1 I-P.
 3. Tank: Glass lined welded steel ASME labeled; multiple flue passages, 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber, encased in corrosion-resistant steel jacket; baked-on enamel finish; floor shield and legs.
 4. Accessories:
 - a. Water Connections: Brass.
 - b. Dip Tube: Brass.
 - c. Drain valve.
 - d. Anode: Magnesium.
 5. Controls: Automatic water thermostat with temperature range adjustable from 120 to 180 degrees F, automatic reset high temperature limiting thermostat factory set at 195 degrees F, gas pressure regulator, multi-ribbon or tubular burner, 100 percent safety shut-off pilot and thermocouple, flue baffle and draft hood.

2.02 DIAPHRAGM-TYPE COMPRESSION TANKS

- A. Manufacturers:
 1. Amtrol Inc: www.amtrol.com/#sle.
 2. Bell & Gossett, a brand of Xylem, Inc: www.bellgossett.com/#sle.
 3. Taco, Inc: www.taco-hvac.com/#sle.
 4. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- 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 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.
- C. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psig.

2.03 IN-LINE CIRCULATOR PUMPS

- A. Manufacturers:

1. Armstrong Fluid Technology: www.armstrongfluidtechnology.com/#sle.
 2. Bell & Gossett, a brand of Xylem, Inc: www.bellgossett.com/#sle.
 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Casing: Bronze, rated for 125 psig working pressure, with stainless steel rotor assembly.
- C. Impeller: Bronze.
- D. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.
- E. Seal: Carbon rotating against a stationary ceramic seat.
- F. Drive: Flexible coupling.

2.04 ELECTRICAL WORK

- A. Electrical characteristics to be as specified or indicated.
- B. Furnish motor starters complete with thermal overload protection and other appurtenances necessary for the motor control specified.
- C. Supply manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices not shown.

EXECUTION

3.01 INSTALLATION

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.
- B. Coordinate with plumbing piping and related fuel piping work to achieve operating system.
- C. Commercial Gas-Fired Water Heaters:
1. Install water heaters on concrete bases.
 2. Connect equipment to water and drain piping using unions or flanges and isolation valves.
 3. Size temperature and relief valves in accordance with CSA ratings. Pipe temperature and pressure relief valves to floor drain.
 4. Adjust compression tank pre-charge to scheduled minimum operating pressure prior to connecting to system.
 5. Install gas shutoff valves on gas supplies to gas water heaters without shutoff valves.
 6. Install gas pressure regulators on gas supplies to gas water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
 7. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
 8. Install automatic gas valves on gas supplies to gas water heaters, if required for operation of safety control.
 9. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater, relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
 10. Install thermometer on outlet piping of water heaters.
- D. Pumps:
1. 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.

END OF SECTION

**SECTION 22 40 00
PLUMBING FIXTURES**

GENERAL

1.01 SECTION INCLUDES

- A. Flush valve water closets.
- B. Wall hung urinals.
- C. Lavatories.
- D. Sinks.
- E. Under-lavatory pipe supply covers.
- F. Showers.
- G. Bi-level, electric water coolers.
- H. Mop sinks.

1.02 RELATED REQUIREMENTS

- A. Section 22 10 05 - Plumbing Piping.
- B. Section 22 10 06 - Plumbing Piping Specialties.
- C. Section 22 30 00 - Plumbing Equipment.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- B. ASHRAE Std 18 - Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration 2008 (Reaffirmed 2013).
- C. ASME A112.6.1M - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use 1997 (Reaffirmed 2017).
- D. ASME A112.18.1 - Plumbing Supply Fittings 2018, with Errata.
- E. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures 2011 (Reaffirmed 2022).
- F. ASME A112.19.2 - Ceramic Plumbing Fixtures 2018, with Errata.
- G. ASME A112.19.3 - Stainless Steel Plumbing Fixtures 2022.
- H. ASME A112.19.5 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks 2022.
- I. ASSE 1014 - Performance Requirements for Backflow Prevention Devices for Hand-Held Showers 2020.
- J. ICC A117.1 - Accessible and Usable Buildings and Facilities 2009.
- K. NSF 61 - Drinking Water System Components - Health Effects 2022, with Errata.
- L. NSF 372 - Drinking Water System Components - Lead Content 2022.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- C. Manufacturer's Instructions: Indicate installation methods and procedures.
- D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept fixtures on-site in factory packaging. Inspect for damage.
- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.06 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures for City of Madison additional warranty requirements.
- B. Provide five year manufacturer warranty for electric water cooler.

PRODUCTS**2.01 GENERAL REQUIREMENTS**

- A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 REGULATORY REQUIREMENTS

- A. Comply with applicable codes for installation of plumbing systems.

2.03 FLUSH VALVE WATER CLOSETS

- A. Water Closets:
 - 1. Bowl: ASME A112.19.2, wall hung, siphon jet flush action, vitreous china, with elongated rim, china bolt caps, 16.5 inches standard, 18" for ADA accessible.
 - 2. Inlet Size: 1-1/2 inches.
 - 3. Manufacturers:
 - a. American Standard, Inc.
 - b. Gerber Plumbing Fixtures LLC.
 - c. Kohler Company.
 - d. PROFLO.
 - e. Toto USA.
 - f. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. Flush Valves:
 - 1. Manufacturers:
 - a. Delany Products.
 - b. Kohler Company.
 - c. Sloan Valve Company.
 - d. Zurn Industries, LLC.
 - e. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
 - 2. Sensor-Operated:
 - a. Type: ASME A112.19.5; chloramine-resistant diaphragm valve complete with vacuum breaker, stops and accessories.
 - b. Mechanism: Solenoid-operated piston or electronic motor-actuated operator with battery powered infrared sensor, and mechanical override or override push button.
 - c. Supplied Volume Capacity: 1.2 gal per flush.
 - 3. Concealed Type: Rough brass, exposed parts chrome-plated, wall escutcheon, wheel handle stop.
- C. Toilet Seats:
 - 1. Manufacturers:
 - a. Bemis Manufacturing Company.
 - b. Church Seat Company.
 - c. Olsonite.
 - d. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2. Plastic: Solid, white finish, elongated shape, open front, extended back complete with self-sustaining hinges, and brass bolts with covers.
- D. Water Closet Carriers:
 1. Manufacturers:
 - a. Jay R. Smith Manufacturing Company.
 - b. JOSAM Company.
 - c. Wade Drains.
 - d. Watts Drainage.
 - e. Zurn Industries, LLC.
 - f. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
 2. ASME A112.6.1M; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers.

2.04 WALL HUNG URINALS

- A. Manufacturers:
 1. American Standard, Inc.
 2. Kohler Company.
 3. Zurn Industries, LLC.
 4. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. Vitreous china, ASME A112.19.2, wall hung with side shields and concealed carrier.
 1. Consumption Volume: 1.0 gal per flush, maximum.
 2. Flush Valve: Concealed (back spud).
 3. Flush Operation: Sensor operated.
 4. Trapway Outlet: Integral.
 5. Supply Size: 3/4 inch.
- C. Flush Valves:
 1. Manufacturers:
 - a. American Standard, Inc.
 - b. Sloan Valve Company.
 - c. Zurn Industries, LLC.
 - d. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
 2. Sensor-Operated:
 - a. Type: ASME A112.19.5; chloramine-resistant, clog-resistant dual-seat diaphragm valve with vacuum breaker, stops and accessories.
 - b. Mechanism: Solenoid-operated piston or electronic motor-actuated operator with low-voltage powered infrared sensor, and mechanical override or override push button.
 - c. Supplied Volume Capacity: 0.125 gal per flush.
 3. Concealed Type: Rough brass, exposed parts chrome-plated, wall escutcheon, wheel handle stop.
- D. Urinal Carriers:
 1. Manufacturers:
 - a. Jay R. Smith Manufacturing Company.
 - b. JOSAM Company.
 - c. Zurn Industries, LLC; Z1221.
 - d. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
 2. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs.

2.05 LAVATORIES

- A. Manufacturers:
 1. American Standard, Inc.

2. Gerber Plumbing Fixtures LLC.
 3. Kohler Company.
 4. Zurn Industries, LLC.
 5. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. Wall-Hung Basin:
1. Vitreous China: ASME A112.19.2; white, rectangular basin with splash lip, front overflow, and hanger. Size as indicated on drawings with 4-inch centerset spacing.
 2. Carrier:
 - a. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded studs for fixture hanger, bearing plate and studs.
- C. Under-Mount Basin:
1. Vitreous China: ASME A112.19.2; white interior, oval shape, front overflow, seal of putty, caulking, or concealed vinyl gasket, and white exterior finish. Size as indicated on drawings.
- D. Metered Faucet:
1. ASME A112.18.1; chrome plated metered mixing faucet with low voltage operated solenoid operator and infrared sensor, aerator and cover plate, open grid strainer.
- E. Sensor Operated Faucet:
1. Spout Style: Standard.
 2. Mixing Valve: Internal, automatic.
 3. Water Supply: 3/8 inch compression connections.
 4. Aerator: Vandal resistant, 0.5 gpm, laminar flow device.
 5. Finish: Polished chrome.

2.06 SINKS

- A. Manufacturers:
1. American Standard, Inc.
 2. Jay R. Smith Manufacturing Company.
 3. Kohler Company.
 4. Elkay.
 5. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. Single Compartment Bowl
1. ASME A112.19.3; 23-1/2 by 18-1/4 by 11-1/2 inch outside dimensions 18 gauge, 0.0478 inch thick, Type 304 stainless steel, self rimming and undercoated, with ledge back drilled for trim.
 2. Drain: 3-1/2 inch crumb cup and tailpiece.
- C. Double Compartment Bowl:
1. ASME A112.19.3; 29 by 22 by 5-1/2 inch outside dimensions 18 gauge, 0.0478 inch thick, Type 304 stainless steel, self-rimming and undercoated, with ledge back drilled for trim.
 2. Drain: 3-1/2 inch crumb cup and tailpiece.
- D. Kitchen Faucets:
1. Manufacturers:
 - a. American Standard, Inc.
 - b. Grohe America, Inc.
 - c. PROFLO.
 - d. Chicago Faucets.
 - e. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
 2. Two-Handle Faucet:
 - a. Spray Type: Full stream spray at 1.75 gpm, maximum.
 - b. ASME A112.18.1, ADA Standards, and NSF 61 compliant assembly.
 - c. Materials: Stainless steel disc valve on brass body with polished chrome finish.

- E. Accessories: Provide braided water supply lines, slip-joint p-trap, and stainless steel basket strainer.

2.07 UNDER-LAVATORY PIPE SUPPLY COVERS

A. General:

1. Insulate exposed drainage piping including hot, cold and tempered water supplies under lavatories or sinks per ADA Standards.
2. Construction: 1/8 inch PVC with antimicrobial, antifungal and UV resistant properties.
 - a. Comply with ASME A112.18.9 for covers on accessible lavatory piping.
 - b. Comply with ICC A117.1.

2.08 SHOWERS

A. Manufacturers:

1. American Standard, Inc.
2. Kohler Company.
3. Aquatic.
4. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

B. Shower Trim:

1. Single Handle: ASME A112.18.1; lever-handle operated, pressure balanced mixing valve with integral service stops, bent shower arm with adjustable spray ball joint shower head with maximum flow, and escutcheon.

C. Hand-Held Shower Head:

1. ASME A112.18.1, adjustable spray hand-held shower head with swivel fitting with ASSE 1014 backflow preventer.
2. Include 60 inch minimum flexible polished stainless steel hose and in-line vacuum breaker
3. Provide 24 inch grab bar with sliding spray holder that locks at any height, allowing use of unit as either a hand-held spray or a fixed shower head.

2.09 BI-LEVEL, ELECTRIC WATER COOLERS

A. Manufacturers:

1. Elkay Manufacturing Company.
2. Haws Corporation.
3. Oasis International.
4. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

B. Water Cooler: Bi-level, electric, mechanically refrigerated; surface mounted, ADA compliant; stainless steel top, vinyl on steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, push button, mounting bracket; integral air cooled condenser and stainless steel grille.

1. Capacity: 8 gph of 50 degrees F water with inlet at 80 degrees F and room temperature of 90 degrees F, when tested in accordance with ASHRAE Std 18.
2. Electrical: 115 VAC, 60 Hertz compressor, 6 foot cord and plug for connection to electric wiring system including grounding connector.

C. Bottle Filler: Materials to match fountain.

2.10 MOP SINKS

A. Manufacturers:

1. Acorn Engineering Company.
2. American Bath Group.
3. Just Manufacturing Company.
4. Zurn Industries, LLC.
5. Mustee.
6. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

B. Material: Molded fiberglass.

- C. Grid Strainer: Stainless steel; integral; removable.
- D. Accessories:
 - 1. 5 feet of 1/2 inch diameter plain end reinforced plastic hose.
 - 2. Hose clamp hanger.
 - 3. Mop hanger.

EXECUTION**3.01 EXAMINATION**

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

3.02 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome-plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.
- C. Install components level and plumb.

3.04 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.05 CLEANING

- A. Clean plumbing fixtures and equipment.

3.06 PROTECTION

- A. Protect installed products from damage due to subsequent construction operations.
- B. Repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 23 05 13
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. General construction and requirements.
- B. Applications.
- C. Single phase electric motors.
- D. Three phase electric motors.

1.02 REFERENCE STANDARDS

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings 2015 (Reaffirmed 2020).
- B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators 2017.
- C. NEMA MG 1 - Motors and Generators 2021.
- D. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
- D. Operation Data: Include instructions for safe operating procedures.
- E. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacture of electric motors for HVAC use, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.
- B. Comply with NFPA 70.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 - PRODUCTS

2.01 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Electrical Service:
 - 1. Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz.
 - 2. Motors Larger than 1/2 Horsepower: 230 volts, three phase, 60 Hz.
- B. Construction:
 - 1. Open drip-proof type except where specifically noted otherwise.
 - 2. Design for continuous operation in 104 degrees F environment.

3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
 4. Motors 1 HP and larger, except specially wound motors and inline pump motors 56 frame and smaller: High energy efficient type.
- C. Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.
- D. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- E. Wiring Terminations:
1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
 2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.02 APPLICATIONS

- A. Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not comply with these specifications.
- B. Single phase motors for shaft mounted fans and centrifugal pumps: Split phase type.
- C. Single phase motors for shaft mounted fans or blowers: Permanent split capacitor type.
- D. Single phase motors for fans, pumps, blowers, and air compressors: Capacitor start type.
- E. Motors located in exterior locations, draw through cooling towers, air cooled condensers, humidifiers, direct drive axial fans, explosion proof environments, and dust collection systems: Totally enclosed type.

2.03 SINGLE PHASE POWER - SPLIT PHASE MOTORS

- A. Starting Torque: Less than 150 percent of full load torque.
- B. Starting Current: Up to seven times full load current.
- C. Breakdown Torque: Approximately 200 percent of full load torque.
- D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
- E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.04 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

- A. Starting Torque: Exceeding one fourth of full load torque.
- B. Starting Current: Up to six times full load current.
- C. Multiple Speed: Through tapped windings.
- D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.05 SINGLE PHASE POWER - CAPACITOR START MOTORS

- A. Starting Torque: Three times full load torque.
- B. Starting Current: Less than five times full load current.
- C. Pull-up Torque: Up to 350 percent of full load torque.
- D. Breakdown Torque: Approximately 250 percent of full load torque.

- E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
- F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
- G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.06 THREE PHASE POWER - SQUIRREL CAGE MOTORS

- A. Starting Torque: Between 1 and 1-1/2 times full load torque.
- B. Starting Current: Six times full load current.
- C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
- D. Design, Construction, Testing, and Performance: Comply with NEMA MG 1 for Design B motors.
- E. Insulation System: NEMA Class B or better.
- F. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
- G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- H. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- I. Nominal Efficiency: As indicated at full load and rated voltage when tested in accordance with IEEE 112.
- J. Nominal Power Factor: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- C. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION

SECTION 23 05 16
EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Flexible pipe connectors.

1.02 RELATED REQUIREMENTS

- A. Section 23 21 13 - Hydronic Piping.

1.03 REFERENCE STANDARDS

- A. UL (DIR) - Online Certifications Directory Current Edition.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.

PART 2 - PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Comply with UL (DIR) requirements.

2.02 FLEXIBLE PIPE CONNECTORS - STEEL PIPING

- A. Inner Hose: Stainless Steel.
- B. Exterior Sleeve: Single braided, stainless steel.
- C. Pressure Rating: 125 psi and 450 degrees F.
- D. Joint: As Specified for Pipe Joints.
- E. Size: Use pipe sized units.
- F. Maximum offset: 3/4 inch on each side of installed center line.

2.03 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

- A. Inner Hose: Bronze.
- B. Exterior Sleeve: Braided bronze.
- C. Pressure Rating: 125 psi and 450 degrees F.
- D. Joint: As specified for pipe joints.
- E. Size: Use pipe sized units.
- F. Maximum offset: 3/4 inch on each side of installed center line.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.
- C. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

END OF SECTION

SECTION 23 05 17
SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Pipe sleeves.
- B. Manufactured sleeve-seal systems.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.

1.03 REFERENCE STANDARDS

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type) 2022a.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2023a.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

PART 2 - PRODUCTS

2.01 PIPE SLEEVES

- A. Vertical Piping:
 - 1. Sleeve Length: 1 inch above finished floor.
 - 2. Provide sealant for watertight joint.
 - 3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
 - 4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
- B. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.
- C. Pipe Passing Through Below Grade Exterior Walls:
 - 1. Zinc coated or cast iron pipe.
 - 2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.
- D. Clearances:
 - 1. Provide allowance for insulated piping.
 - 2. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch greater than external; pipe diameter.
 - 3. All Rated Openings: Caulked tight with fire stopping material in compliance with ASTM E814 to prevent the spread of fire, smoke, and gases.

2.02 MANUFACTURED SLEEVE-SEAL SYSTEMS

- A. Manufacturers:
 - 1. Advance Products & Systems, LLC; Innerlynx: www.apsonline.com/#sle.

2. Flexicraft Industries; PipeSeal: www.flexicraft.com/#sle.
 3. Substitutions: As approved by Engineer.
- B. Modular/Mechanical Seal:
1. Synthetic rubber interlocking links continuously fill annular space between pipe and wall/casing opening.
 2. Provide watertight seal between pipe and wall/casing opening.
 3. Elastomer element size and material in accordance with manufacturer's recommendations.
 4. Glass reinforced plastic pressure end plates.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.

3.02 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Inserts:
1. Provide inserts for placement in concrete formwork.
 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- E. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
 2. Aboveground Piping:
 - a. Pack solid using mineral fiber in compliance with ASTM C592.
 - b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
 3. All Rated Openings: Caulk tight with fire stopping material in compliance with ASTM E814 in accordance with Section 07 84 00 to prevent the spread of fire, smoke, and gases.
 4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.
- F. Manufactured Sleeve-Seal Systems:
1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
 3. Locate piping in center of sleeve or penetration.
 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
 5. Tighten bolting for a water-tight seal.
 6. Install in accordance with manufacturer's recommendations.
- G. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.03 CLEANING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION

SECTION 23 05 19
METERS AND GAUGES FOR HVAC PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Pressure gauges and pressure gauge taps.
- B. Thermometers and thermometer wells.
- C. Static pressure gauges.

1.02 RELATED REQUIREMENTS

- A. Section 23 21 13 - Hydronic Piping.

1.03 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments 2022.
- B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers 2014 (Reapproved 2020).
- C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers 2014 (Reapproved 2021).
- D. UL 393 - Indicating Pressure Gauges for Fire-Protection Service Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

1.05 FIELD CONDITIONS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 - PRODUCTS

2.01 PRESSURE GAUGES

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
 - 2. Moeller Instrument Company, Inc: www.moellerinstrument.com/#sle.
 - 3. Omega Engineering, Inc: www.omega.com/#sle.
 - 4. Ametek/U.S. Gauge Division.
 - 5. Ashcroft.
 - 6. Marsh.
 - 7. Taylor.
 - 8. H.O. Trerice.
 - 9. Weiss.
 - 10. Weksler.
 - 11. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
 - 1. Case: Cast aluminum with phosphor bronze bourdon tube.
 - 2. Size: 4-1/2 inch diameter.
 - 3. Mid-Scale Accuracy: One percent.
 - 4. Scale: Psi.

2.02 PRESSURE GAUGE TAPPINGS

- A. Gauge Cock: Tee or lever handle, brass for maximum 150 psi.
- B. Needle Valve: Brass, 1/4 inch NPT for minimum 150 psi.
- C. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections.
- D. Syphon: Steel, Schedule 40, 1/4 inch angle or straight pattern.

2.03 STEM TYPE THERMOMETERS

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
 - 2. Omega Engineering, Inc: www.omega.com/#sle.
 - 3. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.
 - 4. Ashcroft.
 - 5. Marsh.
 - 6. Taylor.
 - 7. H.O. Trerice.
 - 8. U.S. Gauge.
 - 9. Weiss.
 - 10. Weksler.
 - 11. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
 - 1. Size: 9 inch scale.
 - 2. Window: Clear Lexan.
 - 3. Stem: 3/4 inch NPT brass.
 - 4. Accuracy: 2 percent, per ASTM E77.
 - 5. Calibration: Degrees F.

2.04 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

2.05 TEST PLUGS

- A. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with EPDM or neoprene core, knurled cap with cap strap for temperatures up to 200 degrees F.
- B. Use extended length plugs to clear insulated piping.

2.06 STATIC PRESSURE GAUGES

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
 - 2. Omega Engineering, Inc: www.omega.com/#sle.
 - 3. Veris Industries: www.veris.com/#sle.
 - 4. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.
 - 5. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. 3-1/2 inch diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.
- C. Inclined manometer, red liquid on white background with black figures, front recalibration adjustment, 3 percent of full scale accuracy.

- D. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch diameter tubing.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.
- C. Install pressure gauges with pulsation dampers. Provide gauge cock to isolate each gauge. Provide siphon on gauges in steam systems. Extend nipples and siphons to allow clearance from insulation.
- D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- E. Install thermometer sockets adjacent to controls system thermostat, transmitter, or sensor sockets. Refer to Section 23 09 43.
- F. Coil and conceal excess capillary on remote element instruments.
- G. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- H. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- I. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- J. Locate test plugs where indicated.

3.02 SCHEDULE

- A. Pressure Gauges, Service and Scale Range:
 - 1. Hot Water, 0 to 100 psig
 - 2. Chilled Water, 0 to 100 psig
 - 3. Condenser (Ground Loop) Water, 0 to 60 psig
- B. Stem Type Thermometers, Service and Scale Range:
 - 1. Hot Water, 30 to 240 degrees F.
 - 2. Chilled Water, 0 to 100 degrees F.
 - 3. Condenser (Ground Loop) Water, 0 to 130 degrees F.

END OF SECTION

SECTION 23 05 23
GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Ball valves.
- B. Butterfly valves.
- C. Check valves.

1.02 RELATED REQUIREMENTS

- A. Section 23 05 53 - Identification for HVAC Piping and Equipment.
- B. Section 23 07 19 - HVAC Piping Insulation.
- C. Section 23 21 13 - Hydronic Piping.

1.03 REFERENCE STANDARDS

- A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch 2013 (Reaffirmed 2018).
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250 2020.
- C. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves 2022.
- D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2021.
- E. ASME B16.34 - Valves — Flanged, Threaded, and Welding End 2020.
- F. ASME B31.9 - Building Services Piping 2020.
- G. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings 2004 (Reapproved 2023).
- H. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures 1999 (Reapproved 2022).
- I. ASTM A536 - Standard Specification for Ductile Iron Castings 1984, with Editorial Revision (2019).
- J. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings 2017.
- K. AWWA C606 - Grooved and Shouldered Joints 2022.
- L. MSS SP-67 - Butterfly Valves 2022.
- M. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves 2019.
- N. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends 2010, with Errata .
- O. MSS SP-125 - Check Valves: Gray Iron and Ductile Iron, In-Line, Spring-Loaded, Center-Guided 2018.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.05 QUALITY ASSURANCE

- A. Manufacturer:
 - 1. Obtain valves for each valve type from single manufacturer.
 - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
 - 2. Protect valve parts exposed to piped medium against rust and corrosion.
 - 3. Protect valve piping connections such as weld ends, threads, and flange faces.
 - 4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
 - 5. Secure check valves in either the closed position or open position.
 - 6. Adjust butterfly valves to closed or partially closed position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection and protect flanges and specialties from dirt.
 - a. Provide temporary inlet and outlet caps.
 - b. Maintain caps in place until installation.
 - 2. Store valves in shipping containers and maintain in place until installation.
 - a. Store valves indoors in dry environment.
 - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.
- C. Exercise the following precautions for handling:
 - 1. Handle large valves with sling, modified to avoid damage to exposed parts.
 - 2. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 - PRODUCTS**2.01 APPLICATIONS**

- A. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).
- B. Provide the following valves for the applications if not indicated on drawings:
 - 1. Water System Isolation (Shutoff): Ball and Butterfly.
 - 2. Spring Check (Pump Discharge):
 - a. Size 2 inch and Smaller: Bronze with bronze disc.
 - b. 2-1/2 NPS and Larger: Iron with center-guided metal or center-guided disc with resilient seat.
- C. Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.
- D. Required Valve End Connections for Non-Wafer Types:
 - 1. Steel Pipe:
 - a. Size 2 inch and Smaller: Threaded ends.
 - b. 2-1/2 NPS and Larger: Flanged ends.
 - 2. Copper Tube:
 - a. 2 NPS and Smaller: Threaded ends (Exception: Solder-joint valve-ends).
 - b. 2-1/2 NPS and Larger: Flanged ends.
- E. Water System Valves:
 - 1. 2 NPS and Smaller, Bronze Valves:
 - a. Ball: Full port, two piece, bronze trim.
 - b. Swing Check: Bronze disc, Class 125.
 - c. Spring Check: Bronze disc, Class 125.
 - 2. 2-1/2 NPS and Larger, Iron Valves:
 - a. Ball: Full Port Cast Iron
 - b. Single-Flange Butterfly
 - 1) Butterfly valve to serve as substitute for ball valve as required based on available installation clearance. Substitution to be approved by engineer.
 - c. Swing Check: Metal seats, Class 125.
 - d. Center-Guided Spring Check: Compact Wafer or Globe, metal seat, Class 125.

2.02 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
 - 1. Handwheel: Valves other than quarter-turn types.
 - 2. Hand Lever: Quarter-turn valves 6 inch and smaller.
 - 3. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator, of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- D. Valves in Insulated Piping: Provide 2 NPS stem extensions and the following features:
 - 1. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 2. Butterfly Valves: Extended neck.
- E. Valve-End Connections:
 - 1. Threaded End Valves: ASME B1.20.1.
 - 2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
 - 3. Pipe Flanges and Flanged Fittings 1/2 NPS through 24 NPS: ASME B16.5.
 - 4. Solder Joint Connections: ASME B16.18.
- F. General ASME Compliance:
 - 1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
 - 2. Building Services Piping Valves: ASME B31.9.

2.03 BRONZE, BALL VALVES

- A. General:
 - 1. Fabricate from dezincification resistant material.
 - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Two Piece, Standard Port and Full Port with Bronze or Brass Trim:
 - 1. Comply with MSS SP-110.
 - 2. SWP Rating: 150 psig.
 - 3. CWP Rating: 600 psig.
 - 4. Body: Forged bronze or dezincified-brass alloy.
 - 5. Ends: Threaded.
 - 6. Seats: PTFE.
 - 7. Stem: Blowout-proof Bronze or brass.
 - 8. Ball: Chrome plated brass.
 - 9. Manufacturers:
 - a. American Valve: Milano Series
 - b. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.04 IRON, BALL VALVES

- A. Split Body, Full Port
 - 1. Comply with MSS SP-72.
 - 2. CWP Rating: 200 psig.
 - 3. Body: ASTM A126, gray iron.
 - 4. Ends: Flanged.
 - 5. Seats: PTFE.
 - 6. Ball: PFA Fused.
 - 7. Manufacturers:
 - a. American Valve: 4000 Series
 - b. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.05 IRON, SINGLE FLANGE BUTTERFLY VALVES

- A. Lug Style: Bi-directional dead-end service without use of downstream flange.
 - 1. Comply with MSS SP-67, Type I.
 - 2. CWP Rating: 150 psig and 200 psig.
 - 3. Body Material: ASTM A126 cast iron or ASTM A536 ductile iron.
 - 4. Stem: One or two-piece stainless steel.
 - 5. Seat: EPDM.
 - 6. Disc: Bronze, Aluminum-bronze, Nickel-plated ductile iron, Cast iron with welded nickel edge, or Stainless steel.
 - 7. Manufacturers:
 - a. Centerline Series 200.
 - b. DeZurik BGS II.
 - c. Keystone Fig. 222.
 - d. Nibco LD2000 (2-1/2 - 12-inch) / LD1000 (14-inch and above).
 - e. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.06 BRONZE, SWING CHECK VALVES

- A. Class 125: CWP Rating: 200 psig (1380 kPa):
 - 1. Comply with MSS SP-80, Type 3.
 - 2. Body Design: Horizontal flow.
 - 3. Body Material: Bronze, ASTM B62.
 - 4. Ends: Threaded or Soldered.
 - 5. Disc: Bronze.
 - 6. Manufacturers:
 - a. Crane 137/1342.
 - b. Hammond IB912/IB940.
 - c. Milwaukee 509/1509.
 - d. Nibco T-413-B/S-413-B.
 - e. Lunkenheimer 2144/2145.
 - f. Powell 578/1825.
 - g. Stockham B-309/B-319.
 - h. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.07 IRON, FLANGED END SWING CHECK VALVES

- A. Class 125: CWP Rating: 200 psig (1380 kPa) with Metal Seats:
 - 1. Comply with MSS SP-71, Type I.
 - 2. Design: Clear or full waterway with flanged ends.
 - 3. Body: Gray iron with bolted bonnet in accordance with ASTM A126.
 - 4. Trim: Bronze.
 - 5. Seat: Renewable Bronze.
 - 6. Disc: Cast Iron.
 - 7. Gasket: Asbestos free.
 - 8. Manufacturers:
 - a. Crane 373.
 - b. Hammond IR1124.
 - c. Milwaukee F2974.
 - d. Nibco F918.
 - e. Lunkenheimer 1790.
 - f. Powell 559.
 - g. Stockham G-931.
 - h. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.08 IRON, CENTER-GUIDED SPRING CHECK VALVES

- A. Class 125, Compact-Wafer:
 - 1. Comply with MSS SP-125.
 - 2. Body Material: ASTM A126, cast iron.
 - 3. Style: Spring loaded.
 - 4. Metal Seat: Bronze or Stainless Steel.
- B. Class 125, Globe:
 - 1. Comply with MSS SP-125.
 - 2. Body Material: ASTM A126, cast iron.
 - 3. Style: Spring loaded.
 - 4. Ends: Flanged
 - 5. Metal Seat: Bronze or Stainless Steel.
 - 6. Manufacturers:
 - a. Metraflex 900 Series.
 - b. Milwaukee 1800 Series.
 - c. Mueller Steam 101M-AP/105M-AP.
 - d. Nibco F910 Series.
 - e. Val-Matic 1800 Series.
 - f. Victaulic Series 716 (2-1/2 - 12-inch) / W715 (14 - 24-inch).
 - g. APCO 600 Series.
 - h. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

PART 3 - EXECUTION**3.01 EXAMINATION**

- A. Discard all packing materials and verify that valve interior, including threads and flanges, are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- C. Install check valves where necessary to maintain direction of flow as follows:
 - 1. Orient swing check valves for horizontal or upward vertical flow only. Install valve with hinge pin level.
 - 2. Orient center-guided spring check valves into horizontal or vertical position, between flanges.
- D. Where valves 2-1/2-inch and larger are located more than 12'-0" above mechanical room floors, install valve with stem in horizontal position and provide chainwheel operators with chain terminating 5'-0" above finished floor.

END OF SECTION

SECTION 23 05 29
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Support and attachment components for equipment, piping, and other HVAC/hydronic work.

1.02 RELATED REQUIREMENTS

- A. Section 23 05 48 - Vibration and Seismic Controls for HVAC.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2023.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping 2023.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings 1999, with Editorial Revision (2022).
- F. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2023.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023c.
- H. MFMA-4 - Metal Framing Standards Publication 2004.
- I. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).
- J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.04 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 of any conflicts with or deviations from 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 .

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.

1.06 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 - PRODUCTS**2.01 SUPPORT AND ATTACHMENT COMPONENTS**

- A. General Requirements:
 - 1. Comply with MSS SP-58.
 - 2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
 - 3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 - 4. 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. Include consideration for vibration, equipment operation, and shock loads where applicable.
 - 5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
 - 6. 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. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - c. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. 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 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.
 - 3. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
 - 4. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
- C. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
 - 1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch diameter.
 - b. Piping up to 1 inch (27 mm) nominal: 1/4 inch diameter.
 - c. Piping larger than 1 inch (27 mm) nominal: 3/8 inch diameter.
 - d. Trapeze Support for Multiple Pipes: 3/8 inch diameter.
- D. Thermal Insulated Pipe Supports:
 - 1. General Construction and Requirements:
 - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
 - b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
 - c. Pipe supports to be provided for nominally sized, 1/2 inch to 30 inch iron pipes.

- d. Insulation inserts to consist of rigid polyisocyanurate (urethane) or Calcium silicate insulation surrounded by a galvanized steel protection shield with a minimum 180-degree coverage on bottom supported piping and full 360-degree coverage on clamped piping..
- E. Pipe Supports:
 - 1. Liquid Temperatures Up To 122 degrees F:
 - a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
 - b. Support From Below: MSS SP-58 Types 35 through 38.
 - 2. Operating Temperatures from 122 to 446 degrees F:
 - a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.
 - b. Roller Support: MSS SP-58 Types 41 or 43 through 46, with appropriate saddle of MSS SP-58 Type 39 for insulated pipe.
 - c. Sliding Support: MSS SP-58 Types 35 through 38.
- F. Beam Clamps: MSS SP-58 Types 19 through 23, 25 or 27 through 30 based on required load.
 - 1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
 - 2. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
- G. Riser Clamps: MSS SP-58 Type 8, carbon steel riser clamp.
 - 1. Provide copper plated clamps for copper tubing support.
 - 2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
- H. Strut Clamps: Two-piece pipe clamp.
- I. Insulation Clamps: Two bolt-type clamps designed for installation under insulation.
- J. Pipe Hangers: For a given pipe run, use hangers of the same type and material.
 - 1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
 - 2. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.
- K. Intermediate Pipe Guides: Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.
 - 1. Pipe Diameter 6 inches and Smaller: Provide minimum clearance of 0.16 inch.
 - 2. Pipe Diameter 8 inches: Provide U-bolts with double nuts providing minimum clearance of 0.28 inch.
 - 3. Pipe Diameter 8 inches: 0.625 inch U-bolt.
 - 4. Pipe Diameter 10 inches: 0.75 inch U-bolt.
 - 5. Pipe Diameter 12 to 16 inches: 0.875 inch U-bolt.
 - 6. Pipe Diameter 18 to 30 inches: 1 inch U-bolt.
- L. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- M. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
 - 1. Provide steel pedestals with thermoplastic or rubber base 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.
 - 2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - 3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
 - 4. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
- N. Pipe Insulation Protection Shields:
 - 1. MSS SP-58 Type 40.
 - 2. Shield Material: Galvanized carbon steel of not less than 18-gauge.

3. For use on insulated pipe with outer diameter 2-1/2-inch and larger.
4. Minimum Shield Length: 12-inches.
- O. 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. 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

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- 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.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- C. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- D. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- F. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- G. 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 high concrete pad constructed in accordance with Section 03 30 00.
 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

- H. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
- I. Secure fasteners according to manufacturer's recommended torque settings.
- J. Remove temporary supports.

END OF SECTION

SECTION 23 05 48
VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Vibration isolation requirements.
- B. Vibration-isolated equipment support bases.
- C. Vibration isolators.

1.02 RELATED REQUIREMENTS

- A. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.03 REFERENCE STANDARDS

- A. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications Most Recent Edition Cited by Referring Code or Reference Standard.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
 - 1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
- C. Shop Drawings - Vibration Isolation Systems:
 - 1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
 - 2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

- A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
 - 1. Select vibration isolators to provide required static deflection.
 - 2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
 - 3. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 1-inch operating clearance beneath base unless otherwise indicated.
- D. Piping Isolation:
 - 1. Provide vibration isolators for piping supports:
 - a. Located within 50 feet of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
 - 2. Minimum Static Deflection:
 - a. First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch deflection required.
 - b. Remainder of Supports: 0.75 inch deflection unless otherwise indicated.

3. Suspended Piping, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
4. Floor-Mounted Piping, Nonseismic Applications: Use open (unhoused) spring isolators.
5. Use modular seal or approved resilient material where vibration-isolated piping penetrates building elements (e.g., walls, floors) arranged to prevent vibration transmission to structure.

2.02 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

- A. Type IB - Vibration-Isolated Concrete Inertia Bases:
 1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
 2. Minimum Base Depth: 6 inches.
 3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
 4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
 5. Concrete: Filled on site with minimum 3000 psi concrete.

2.03 VIBRATION ISOLATORS

- A. General Requirements:
 1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
 2. Spring Elements for Spring Isolators:
 - a. Color code or otherwise identify springs to indicate load capacity.
 - b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
 - c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
 - d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
 - e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
 - f. Selected to function without undue stress or overloading.
- B. Vibration Isolators for Nonseismic Applications:
 1. Type 1 - Resilient Material Isolator Pads:
 - a. Description: Single or multiple layer waffle pads utilizing elastomeric (e.g. neoprene, rubber) isolator material.
 - b. Pad Thickness and Size: As required for 40 durometer load rating.
 - c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.
 2. Type 2 - Resilient Material Isolator Mounts, Nonseismic:
 - a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g. neoprene, rubber) isolator material, double deflection mount having a minimum static deflection of 0.35 inches. All metal surfaces shall be neoprene covered to prevent corrosion and have friction pads, both top and bottom. Bolt holes shall be provided on the bottom and a tapped hole with capscrew and washer on top.
 3. Type 3 - Open (Unhoused) Spring Isolators:
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
 - b. Bottom Load Plate: Nonskid, molded, elastomeric (e.g. neoprene, rubber) isolator material or steel with nonskid elastomeric isolator friction pad with provisions for bolting to supporting structure as required.
 - c. Furnished with integral leveling device for positioning and securing supported equipment.
 4. Type 4 - Restrained Spring Isolators, Nonseismic:
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.

- b. Bottom Load Plate: Steel with nonskid elastomeric (e.g. neoprene, rubber) isolator pad with provisions for bolting to supporting structure as required.
 - c. Furnished with integral leveling device for positioning and securing supported equipment.
 - d. Provides constant free and operating height.
- 5. Type 5 - Spring Isolator Hangers, Nonseismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric (e.g. neoprene, rubber) element for the lower hanger rod connection.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
- 6. Type 7 - Combination Resilient Material/Spring Isolator Hangers, Nonseismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g. neoprene, rubber) isolator material for the upper hanger rod connection.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
- 7. Type T - Horizontal Thrust Restraints:
 - a. Description: Assembly utilizing free-standing, laterally stable steel spring designed for resisting horizontal motion due to thrust (e.g., air pressure from a fan), and intended for installation in pairs.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Secure fasteners according to manufacturer's recommended torque settings.
- D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- E. Vibration Isolation Systems:
 - 1. Vibration-Isolated Equipment Support Bases:
 - a. Provide specified minimum clearance beneath base.
 - 2. Spring Isolators:
 - a. Position equipment at operating height; provide temporary blocking as required.
 - b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
 - c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
 - 3. Isolator Hangers:
 - a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
 - b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
 - 4. Thrust Restraints:

- a. Adjust restraint movement under normal operating static pressure.
- 5. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
- 6. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
- 7. Adjust isolators to be free of isolation short circuits during normal operation.
- 8. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

END OF SECTION

SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe markers.
- E. Ceiling tacks.

1.02 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems 2023.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials 2017.

1.03 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- E. Project Record Documents: Record actual locations of tagged valves.

PART 2 - PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Air Handling Units: Nameplates.
- B. Air Terminal Units: Tags.
- C. Control Panels: Nameplates.
- D. Dampers: Ceiling tacks, where located above lay-in ceiling.
- E. Ductwork: Stencilled painting.
- F. Heat Transfer Equipment: Nameplates.
- G. Instrumentation: Tags.
- H. Piping: Pipe markers.
- I. Pumps: Nameplates.
- J. Tanks: Nameplates.
- K. Thermostats: Nameplates.
- L. Valves: Tags.

2.02 NAMEPLATES

- A. Letter Color: White.
- B. Letter Height: 1/2 inch.
- C. Background Color: Black.
- D. Plastic: 1/16-inch thick plastic laminate, beveled edges, screw mounting. Comply with ASTM D709.

2.03 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.
- B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- C. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
 - 1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
 - 2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
 - 3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.
 - 4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.
 - 5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3-1/2 inch high letters.
 - 6. Ductwork and Equipment: 2-1/2 inch high letters.
- B. Stencil Paint: As specified in Section 09 91 23, semi-gloss enamel, colors complying with ASME A13.1.

2.05 PIPE MARKERS

- A. Color: Comply with ASME A13.1.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.06 CEILING TACKS

- A. Description: Steel with 3/4 inch diameter color coded head.
- B. Color code as follows:
 - 1. HVAC Equipment: Yellow.
 - 2. Fire Dampers and Smoke Dampers: Red.
 - 3. Heating/Cooling Valves: Blue.

PART 3 - EXECUTION**3.01 PREPARATION**

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
 - B. Install tags with corrosion resistant chain.
 - C. Install plastic pipe markers in accordance with manufacturer's instructions.
 - D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
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- E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- F. Use tags on piping 3/4 inch diameter and smaller.
 - 1. Identify service, flow direction, and pressure.
 - 2. Install in clear view and align with axis of piping.
 - 3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- G. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

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

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic systems.
- C. Measurement of final operating condition of HVAC systems.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition 2016.
- B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems 2008, with Errata (2019).
- C. NEBB (TAB) - Procedural Standard for Testing Adjusting and Balancing of Environmental Systems 2019.
- D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing 2002.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
 - 1. Submit six weeks prior to starting the testing, adjusting, and balancing work.
 - 2. Include certification that the plan developer has reviewed Contract Documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
 - 3. Include at least the following in the plan:
 - a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - c. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - d. Final test report forms to be used.
 - e. Detailed step-by-step procedures for TAB work for each system and issue, including:
 - 1) Terminal flow calibration (for each terminal type).
 - 2) Diffuser proportioning.
 - 3) Branch/submain proportioning.
 - 4) Total flow calculations.
 - 5) Rechecking.
 - 6) Diversity issues.
 - f. Expected problems and solutions, etc.
 - g. Criteria for using air flow straighteners or relocating flow stations and sensors; analogous explanations for the water side.
 - h. Details of how TOTAL flow will be determined; for example:
 - 1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
 - 2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.

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- i. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
 - j. Confirmation of understanding of the outside air ventilation criteria under all conditions.
 - k. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
 - l. Method of checking building static and exhaust fan and/or relief damper capacity.
 - m. Proposed selection points for sound measurements and sound measurement methods.
 - n. Methods for making coil or other system plant capacity measurements, if specified.
 - o. Time schedule for TAB work to be done in phases (by floor, etc.).
 - p. Description of TAB work for areas to be built out later, if any.
 - q. Time schedule for deferred or seasonal TAB work, if specified.
 - r. False loading of systems to complete TAB work, if specified.
 - s. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
 - t. Interstitial cavity differential pressure measurements and calculations, if specified.
 - u. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
 - v. Procedures for formal progress reports, including scope and frequency.
 - w. Procedures for formal deficiency reports, including scope, frequency and distribution.
- C. Field Logs: Submit at least twice a week to the Construction Manager.
- D. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
- E. Progress Reports.
- F. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- 1. Submit under provisions of Section 01 40 00.
 - 2. Revise TAB plan to reflect actual procedures and submit as part of final report.
 - 3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
 - 4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 - 5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 - 6. Units of Measure: Report data in I-P (inch-pound) units only.
 - 7. Include the following on the title page of each report:
 - 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.
- G. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.
-

PART 2 - PRODUCTS - NOT USED**PART 3 - EXECUTION****3.01 GENERAL REQUIREMENTS**

- A. Perform total system balance in accordance with one of the following:
 - 1. AABC (NSTSB), AABC National Standards for Total System Balance.
 - 2. SMACNA (TAB).
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. TAB Agency Qualifications:
 - 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 - 2. Having minimum of three years documented experience.
 - 3. Certified by one of the following:
 - a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
 - b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
 - c. TABBB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 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 that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

- A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
 - 1. Require attendance by all installers whose work will be tested, adjusted, or balanced.

- B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.
- C. Provide additional balancing devices as required.

3.04 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
 - 1. Running log of events and issues.
 - 2. Discrepancies, deficient or uncompleted work by others.
 - 3. Contract interpretation requests.
 - 4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.06 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 extend 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 allowances 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.
- M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.
- N. 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.
- O. On fan powered VAV boxes, adjust air flow switches for proper operation.

3.07 WATER SYSTEM PROCEDURE

- 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.

3.08 MINIMUM DATA TO BE REPORTED

- A. Electric Motors:
 - 1. Manufacturer.
 - 2. Model/Frame.
 - 3. HP/BHP.
 - 4. Phase, voltage, amperage; nameplate, actual, no load.
 - 5. RPM.
 - 6. Service factor.
 - 7. Starter size, rating, heater elements.
 - 8. Sheave Make/Size/Bore.
- B. Pumps:
 - 1. Identification/number.
 - 2. Manufacturer.
 - 3. Size/model.
 - 4. Impeller.
 - 5. Service.
 - 6. Design flow rate, pressure drop, BHP.
 - 7. Actual flow rate, pressure drop, BHP.
 - 8. Discharge pressure.
 - 9. Suction pressure.
 - 10. Total operating head pressure.
 - 11. Shut off, discharge and suction pressures.
 - 12. Shut off, total head pressure.
- C. Heat Recovery Chillers:

-
1. Manufacturer.
 2. Capacity.
 3. Model number.
 4. Serial number.
 5. Evaporator entering water temperature, design and actual.
 6. Evaporator pressure drop, design and actual.
 7. Condenser entering water temperature, design and actual.
 8. Condenser water flow rate, design and actual.
- D. Cooling Coils:
1. Identification/number.
 2. Location.
 3. Service.
 4. Manufacturer.
 5. Air flow, design and actual.
 6. Entering air DB temperature, design and actual.
 7. Entering air WB temperature, design and actual.
 8. Leaving air DB temperature, design and actual.
 9. Leaving air WB temperature, design and actual.
 10. Water flow, design and actual.
 11. Water pressure drop, design and actual.
 12. Entering water temperature, design and actual.
 13. Leaving water temperature, design and actual.
 14. Saturated suction temperature, design and actual.
 15. Air pressure drop, design and actual.
- E. Heating Coils:
1. Identification/number.
 2. Location.
 3. Service.
 4. Manufacturer.
 5. Air flow, design and actual.
 6. Water flow, design and actual.
 7. Water pressure drop, design and actual.
 8. Entering water temperature, design and actual.
 9. Leaving water temperature, design and actual.
 10. Entering air temperature, design and actual.
 11. Leaving air temperature, design and actual.
 12. Air pressure drop, design and actual.
- F. Air Moving Equipment:
1. Location.
 2. Manufacturer.
 3. Model number.
 4. Serial number.
 5. Arrangement/Class/Discharge.
 6. Air flow, specified and actual.
 7. Return air flow, specified and actual.
 8. Outside air flow, specified and actual.
 9. Total static pressure (total external), specified and actual.
 10. Inlet pressure.
 11. Discharge pressure.
-

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12. Sheave Make/Size/Bore.
 13. Number of Belts/Make/Size.
 14. Fan RPM.
- G. Return Air/Outside Air:
1. Identification/location.
 2. Design air flow.
 3. Actual air flow.
 4. Design return air flow.
 5. Actual return air flow.
 6. Design outside air flow.
 7. Actual outside air flow.
 8. Return air temperature.
 9. Outside air temperature.
 10. Required mixed air temperature.
 11. Actual mixed air temperature.
 12. Design outside/return air ratio.
 13. Actual outside/return air ratio.
- H. Exhaust Fans:
1. Location.
 2. Manufacturer.
 3. Model number.
 4. Serial number.
 5. Air flow, specified and actual.
 6. Total static pressure (total external), specified and actual.
 7. Inlet pressure.
 8. Discharge pressure.
 9. Sheave Make/Size/Bore.
 10. Number of Belts/Make/Size.
 11. Fan RPM.
- I. Duct Traverses:
1. System zone/branch.
 2. Duct size.
 3. Area.
 4. Design velocity.
 5. Design air flow.
 6. Test velocity.
 7. Test air flow.
 8. Duct static pressure.
 9. Air temperature.
 10. Air correction factor.
- J. Air Monitoring Stations:
1. Identification/location.
 2. System.
 3. Size.
 4. Area.
 5. Design velocity.
 6. Design air flow.
 7. Test velocity.
 8. Test air flow.
-

K. Flow Measuring Stations:

1. Identification/number.
2. Location.
3. Size.
4. Manufacturer.
5. Model number.
6. Serial number.
7. Design Flow rate.
8. Design pressure drop.
9. Actual/final pressure drop.
10. Actual/final flow rate.
11. Station calibrated setting.

L. Terminal Unit Data:

1. Manufacturer.
2. Type, constant, variable, single, dual duct.
3. Identification/number.
4. Location.
5. Model number.
6. Size.
7. Minimum static pressure.
8. Minimum design air flow.
9. Maximum design air flow.
10. Maximum actual air flow.
11. Inlet static pressure.

M. Air Distribution Tests:

1. Air terminal number.
2. Room number/location.
3. Terminal type.
4. Terminal size.
5. Area factor.
6. Design velocity.
7. Design air flow.
8. Test (final) velocity.
9. Test (final) air flow.
10. Percent of design air flow.

END OF SECTION

**SECTION 23 07 13
DUCT INSULATION****PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Duct insulation.
- B. Insulation jackets.

1.02 RELATED REQUIREMENTS

- A. Section 23 05 53 - Identification for HVAC Piping and Equipment.
- B. Section 23 31 00 - HVAC Ducts and Casings: Glass fiber ducts.

1.03 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2021.
- B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications 2013 (Reapproved 2019).
- C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation 2014 (Reapproved 2019).
- D. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material) 2019.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023c.
- F. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a, with Editorial Revision (2023).
- G. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015, with Editorial Revision (2021).
- H. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2020.
- I. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.05 QUALITY ASSURANCE

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

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 - PRODUCTS**2.01 REGULATORY REQUIREMENTS**

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, FLEXIBLE

- A. Manufacturer:
1. CertainTeed Corporation: www.certainteed.com/#sle.
 2. Johns Manville: www.jm.com/#sle.
 3. Knauf Insulation; Atmosphere Duct Wrap: www.knaufinsulation.com/#sle.
 4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
 5. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
1. K value: 0.25 at 75 degrees F, when tested in accordance with ASTM C518.
 2. Maximum Service Temperature: 250 degrees F.
 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
- C. Vapor Barrier Jacket:
1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 3. Secure with pressure sensitive tape.
- D. Indoor Vapor Barrier Mastic:
1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

2.03 GLASS FIBER, RIGID

- A. Manufacturer:
1. CertainTeed Corporation: www.certainteed.com/#sle.
 2. Johns Manville: www.jm.com/#sle.
 3. Knauf Insulation: www.knaufinsulation.com/#sle.
 4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
 5. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. Insulation: ASTM C612; rigid, noncombustible blanket.
1. K Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
 2. Maximum Service Temperature: 450 degrees F.
 3. Maximum Water Vapor Absorption: 5.0 percent.
 4. Maximum Density: 3.0 lb/cu ft.
- C. Vapor Barrier Jacket:
1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 3. Secure with pressure sensitive tape.
- D. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- E. Indoor Vapor Barrier Finish:
1. Vinyl emulsion type acrylic, compatible with insulation, black color.

2.04 JACKETS

- A. SELF-ADHERING JACKET

1. 5-ply, self-adhering multiple laminated waterproofing material with reflective aluminum foil, high density polymer films and cold weather acrylic adhesive providing zero (0.0) permeance. Minimum 6 mils material thickness, 25lb puncture resistance when tested in accordance with ASTM D1000 and flame spread/smoke developed rating of 10/20 when tested in accordance with UL 723. Venture Clad 1577CW & 1577CW-E
2. Vapor retarding tape shall be specifically designed and manufactured for use with the self-adhering jacket specified above. Tape shall be provided by the same manufacturer that provides jacketing. Vapor retarding tapes used with self-adhering jackets shall have a maximum permeance of 0.0 perms.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Test ductwork for design pressure prior to applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Insulated Ducts Conveying Air Below Ambient Temperature:
 1. Finish with tape and vapor barrier jacket.
 2. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 3. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- D. Insulated Ducts Conveying Air Above Ambient Temperature:
 1. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

3.03 SCHEDULES

- A. Outside Air Intake Ducts: Glass Fiber, Rigid. 2 inches thick.
- B. Exposed Supply Ducts: Glass Fiber, Rigid. 2 inches thick.
- C. Concealed Supply Ducts: Glass Fiber, Flexible. 1-1/2 inches thick.
- D. Exhaust and relief ducts downstream of motorized backdraft dampers: Glass Fiber, Rigid. 2 inches thick.

END OF SECTION

SECTION 23 07 16
HVAC EQUIPMENT INSULATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Equipment insulation.
- B. Covering.

1.02 RELATED REQUIREMENTS

- A. Section 23 05 53 - Identification for HVAC Piping and Equipment.
- B. Section 23 21 13 - Hydronic Piping: Placement of hangers and hanger inserts.
- C. Section 23 21 14 - Hydronic Specialties.

1.03 REFERENCE STANDARDS

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus 2019, with Editorial Revision (2023).
- D. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2021.
- E. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form 2023.
- F. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications 2013 (Reapproved 2019).
- G. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type) 2022a.
- H. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation 2014 (Reapproved 2019).
- I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023c.
- J. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a, with Editorial Revision (2023).
- K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

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

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 - PRODUCTS**2.01 REGULATORY REQUIREMENTS**

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, FLEXIBLE

- A. Manufacturers:
 - 1. CertainTeed Corporation: www.certainteed.com/#sle.
 - 2. Johns Manville Corporation: www.jm.com/#sle.
 - 3. Knauf Insulation; Atmosphere Duct Wrap: www.knaufinsulation.com/#sle.
 - 4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
 - 5. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. Insulation: ASTM C553; flexible, noncombustible.
 - 1. K Value: 0.25 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
 - 2. Maximum Service Temperature: 250 degrees F.
 - 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
- C. Vapor Barrier Jacket: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 - 1. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 - 2. Secure with outward clinch expanding staples and vapor barrier mastic.

2.03 GLASS FIBER, RIGID

- A. Manufacturer:
 - 1. CertainTeed Corporation: www.certainteed.com/#sle.
 - 2. Johns Manville Corporation: www.jm.com/#sle.
 - 3. Knauf Insulation: www.knaufinsulation.com/#sle.
 - 4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
 - 5. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
 - 1. K Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
 - 2. Maximum Service Temperature: 450 degrees F.
 - 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
 - 4. Maximum Density: 3.0 lb/cu ft.
- C. Vapor Barrier Jacket:
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 - 3. Secure with outward clinch expanding staples and vapor barrier mastic.

2.04 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturer:
 - 1. Aeroflex USA, Inc; Aerocel AC Sheet and Roll: www.aeroflexusa.com/#sle.

2. Armacell LLC; ArmaFlex Ultra with FlameDefense: www.armacell.us/#sle.
 3. K-Flex USA LLC; Insul-Sheet: www.kflexusa.com/#sle.
 4. Substitutions: As approved by Engineer.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
1. Minimum Service Temperature: Minus 40 degrees F.
 2. Maximum Service Temperature: 220 degrees F.
 3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.05 JACKETS

- A. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
1. Thickness: 0.016 inch sheet.
 2. Finish: Smooth.
 3. Joining: Longitudinal slip joints and 2 inch laps.
 4. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that equipment has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.
- C. Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.

3.03 SCHEDULE

- A. Heating Systems:
1. Reheat coil casing in exposed supply ducts: Glass Fiber, Rigid. 2 inches thick.
 2. Reheat coil casing in concealed supply ducts: Glass Fiber, Flexible. 1-1/2 inches thick.
 3. Air Separators: Flexible Elastomeric. 1 inches thick.
 4. Expansion Tanks: Flexible Elastomeric. 1 inches thick.
- B. Cooling Systems:
1. Air Separators: Flexible Elastomeric. 1 inches thick.
 2. Expansion Tanks: Flexible Elastomeric. 1 inches thick.

END OF SECTION

SECTION 23 07 19 HVAC PIPING INSULATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Piping insulation.
- B. Flexible removable and reusable blanket insulation.
- C. Jackets and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 23 21 13 - Hydronic Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

- A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus 2019, with Editorial Revision (2023).
- B. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation 2022a.
- C. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel 2008 (Reapproved 2023).
- D. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation 2023.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023c.
- F. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a, with Editorial Revision (2023).
- G. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 - PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, RIGID

- A. Manufacturers:
 - 1. CertainTeed Corporation: www.certainteed.com/#sle.

2. Johns Manville Corporation: www.jm.com/#sle.
 3. Knauf Insulation: www.knaufinsulation.com/#sle.
 4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
 5. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
1. K Value: ASTM C177, 0.24 at 75 degrees F.
 2. Maximum Service Temperature: 850 degrees F.
 3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
1. K Value: ASTM C177, 0.24 at 75 degrees F.
 2. Maximum Service Temperature: 650 degrees F.
 3. Maximum Moisture Absorption: 0.2 percent by volume.
- D. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

2.03 POLYISOCYANURATE CELLULAR PLASTIC

- A. Manufacturers:
1. Johns Manville Corporation: www.jm.com/#sle.
 2. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. Insulation Material: ASTM C591, rigid molded modified polyisocyanurate cellular plastic.
1. Dimension: Comply with requirements of ASTM C585.
 2. K Value: 0.18 at 75 degrees F, when tested in accordance with ASTM C518.
 3. Minimum Service Temperature: Minus 70 degrees F.
 4. Maximum Service Temperature: 300 degrees F.
 5. Water Absorption: 0.5 percent by volume, maximum, when tested in accordance with ASTM D2842.
 6. Moisture Vapor Transmission: 4.0 perm inch.
 7. Connection: Waterproof vapor barrier adhesive.

2.04 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturers:
1. Aeroflex USA, Inc; Aerocel Stay-Seal with Protape (SSPT): www.aeroflexusa.com/#sle. Armacell LLC;
 2. ArmaFlex Ultra with FlameDefense: www.armacell.us/#sle. K-Flex USA LLC;
 3. K-Flex Titan: www.kflexusa.com/#sle.
 4. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
1. Minimum Service Temperature: Minus 40 degrees F.
 2. Maximum Service Temperature: 180 degrees F.
 3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.05 JACKETS

- A. PVC Plastic.
1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil.

- e. Connections: Brush on welding adhesive.
- 2. Covering Adhesive Mastic: Compatible with insulation.
- B. Vapor Barrier Membranes: ASTM C1136, Type IX.
 - 1. Multilayer Laminate Vapor Barrier:
 - a. Provide multilayer laminate with 1.0 mil foil, reversible.
 - b. Thickness: 2.4 mil.
 - c. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.
 - d. Manufacturers:
 - 1) Polyguard Products; ZERO-PERM: www.polyguardproducts.com/#sle.
 - 2) Substitutions: See Section 01 25 13 - Product Substitution Procedures.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated Pipes Conveying Fluids Below Ambient Temperature:
 - 1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
 - 2. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive.
- E. Glass Fiber Insulated Pipes Conveying Fluids Below Ambient Temperature:
 - 1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- F. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.
- G. Glass Fiber Insulated Pipes Conveying Fluids Above Ambient Temperature:
 - 1. Provide standard jackets, with or without vapor barrier, factory-applied, or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- H. Inserts and Shields:
 - 1. Application: Piping 1-1/2 inches diameter or larger.
 - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 - 3. Insert location: Between support shield and piping and under the finish jacket.
 - 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 - 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions.

3.03 SCHEDULE

- A. Heating Systems (including above grade glycol system):
 - 1. Heating Water: Glass Fiber, Rigid.
 - a. 1-1/2 inches thick for piping 1-1/2 inches and smaller in diameter.
 - b. 2 inches thick for piping larger than 1-1/2 inches in diameter.
 - c. Provide full PVC Jacketing where exposed.
- B. Cooling Systems:
 - 1. Chilled Water: Polyisocyanurate Cellular Plastic.
 - a. 1-1/2 inches thick.
 - b. Provide full PVC Jacketing where exposed.
 - 2. Condenser Water: Polyisocyanurate Cellular Plastic
 - a. 1-1/2 inches thick.
 - b. Provide full PVC Jacketing where exposed.
 - 3. Cold Condensate Drains:
 - a. Glass Fiber, Rigid. 1/2 inches thick.
 - 4. Refrigerant Piping:
 - a. Flexible Elastomeric. 1/2 inches thick

END OF SECTION

SECTION 23 09 13
INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Control panels.
- B. Control Valves:
 - 1. Ball valves and actuators.
 - 2. Globe pattern.
 - 3. Butterfly pattern.
 - 4. Electronic operators.
- C. Dampers.
- D. Damper Operators:
 - 1. Electric operators.
- E. Input/Output Sensors:
 - 1. Temperature sensors.
 - 2. Humidity sensors.
 - 3. Static pressure (air pressure) sensors.
 - 4. Equipment operation (current) sensors.
 - 5. Carbon dioxide sensors.
 - 6. Occupancy Sensors.
- F. Transmitters:
 - 1. Building static pressure transmitters.
 - 2. Pressure transmitters.
 - 3. Air pressure transmitters.

1.02 RELATED REQUIREMENTS

- A. Section 23 05 19 - Meters and Gauges for HVAC Piping: Thermometer sockets and gauge taps.
- B. Section 23 09 23 - Direct-Digital Control System for HVAC.
- C. Section 23 09 93 - Sequence of Operations for HVAC Controls.
- D. Section 23 21 13 - Hydronic Piping: Installation of control valves, flow switches, temperature sensor sockets, and gauge taps.
- E. Section 23 21 14 - Hydronic Specialties.
- F. Section 23 33 00 - Air Duct Accessories: Installation of automatic dampers.
- G. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating 2018.
- B. ANSI/FCI 70-2 - Control Valve Seat Leakage 2021.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.

- C. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.
- D. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
- E. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.
 - 1. Revise shop drawings to reflect actual installation and operating sequences.
- F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years experience approved by manufacturer.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.01 EQUIPMENT - GENERAL

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

2.02 CONTROL PANELS

- A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face.
- B. NEMA 250, general purpose utility enclosures with enameled finished face panel.
- C. Provide common keying for all panels.

2.03 CONTROL VALVES

- A. Ball Valves:
 - 1. Service: Use for chilled water or hot water.
 - 2. Flow Characteristic: Include 2-way and 3-way diverting operation configured to fail normally closed (NC).
 - 3. Replacements in Kind: Provide pressure-independent type.
 - 4. Rangeability: 500 to 1.
 - 5. ANSI Rating: Class 150.
 - 6. Leakage: Class IV (0.1 percent of rated capacity) per ANSI/FCI 70-2.
 - 7. Body Size:
 - a. Under 2-1/2 inches:
 - 1) Connection: NPT.
 - 2) Materials:
 - (a) Body: Brass.
 - (b) Flanges: Ductile iron.
 - (c) Ball: Chrome-plated brass.
 - (d) Stem: Nickel-plated brass.

- (e) Seat: Graphite-reinforced PTFE with EPDM O-Ring backing.
 - (f) Stem Seal: EPDM O-Rings.
 - (g) Flow Control Disk: Thermoplastic synthetic-resin.
 - b. 2-1/2 inches and Above:
 - 1) Connection Type: Flanged.
 - 2) Materials:
 - (a) Body: Brass.
 - (b) Flanges: Ductile iron.
 - (c) Ball: 300 series stainless steel.
 - (d) Stem: 300 series stainless steel.
 - (e) Seat: Graphite-reinforced PTFE with EPDM O-Ring backing.
 - (f) Stem Seal: EPDM O-Rings.
 - (g) Flow Control Disk: Thermoplastic synthetic-resin.
 - c. Service Temperature:
 - 1) Fluid Side: 0 to 284 degrees F liquid or 25 psig steam.
 - 2) Ambient Side: From minus 4 to 122 degrees F.
- B. Globe Pattern:
 - 1. Up to 2 inches: Bronze body, bronze trim, rising stem, renewable composition disc, screwed ends.
 - 2. Over 2 inches: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, renewable seat and disc.
 - 3. Hydronic Systems:
 - a. Rate for service pressure of 125 psig at 250 degrees F.
 - b. Replaceable plugs and seats of stainless steel.
 - c. Size for 5 psig maximum pressure drop at design flow rate.
 - d. Two-way valves shall have equal percentage characteristics, three way valves linear characteristics. Size two-way valve operators to close valves against pump shut off head.
- C. Butterfly Pattern:
 - 1. Iron body, bronze disc, resilient replaceable seat for service to 250 degrees F wafer or lug ends, extended neck.
 - 2. Hydronic Systems:
 - a. Rate for service pressure of 125 psig at 250 degrees F.
 - b. Size for 1 psig maximum pressure drop at design flow rate.
- D. Electronic Operators:
 - 1. Valves shall spring return to normal position as indicated on freeze, fire, or temperature protection.
 - 2. Select operator for full shut off at maximum pump differential pressure.
 - 3. Assembly: Factory-mounted.
 - 4. Input: 0 to 10 VDC configured for proportional control.
 - 5. Accessories: Provide with valve position indicator and manual override.

2.04 DAMPERS

- A. Performance: Test in accordance with AMCA 500-D.
- B. Frames: Galvanized steel, welded or riveted with corner reinforcement, minimum 12 gauge, 0.1046 inch.
- C. Blades: Galvanized steel, maximum blade size 8 inches wide, 48 inches long, minimum 22 gauge, 0.0299 inch, attached to minimum 1/2 inch shafts with set screws.
- D. Blade Seals: Synthetic elastomeric, inflatable, mechanically attached, field replaceable.
- E. Jamb Seals: Spring stainless steel.

- F. Shaft Bearings: Oil impregnated sintered bronze.
- G. Linkage Bearings: Oil impregnated sintered bronze.
- H. Leakage: Less than one percent based on approach velocity of 2000 ft per min and 4 inches wg.
- I. Maximum Pressure Differential: 6 inches wg.
- J. Temperature Limits: Minus 40 to 200 degrees F.

2.05 DAMPER OPERATORS

- A. General: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two position control and for fail safe operation.
 - 1. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.
 - 2. Provide one operator for maximum 36 sq ft damper section.
- B. Electric Operators:
 - 1. Spring return, adjustable stroke motor having oil immersed gear train, with auxiliary end switch.
 - 2. Input: 0 to 10 VDC configured for proportional control.
 - 3. Accessories: Provide with valve position indicator and manual override.

2.06 INPUT/OUTPUT SENSORS

- A. Temperature Sensors:
 - 1. Use thermistor or RTD type temperature sensing elements with characteristics resistant to moisture, vibration, and other conditions consistent with the application without affecting accuracy and life expectancy.
 - 2. Construct RTD of nickel or platinum with base resistance of 1000 ohms at 70 degrees F.
 - 3. 100 ohm platinum RTD is acceptable if used with project DDC controllers.
 - 4. Temperature Sensing Device: Compatible with project DDC controllers.
 - 5. Performance Characteristics:
 - a. RTD:
 - 1) Room Sensor Accuracy: Plus/minus 0.50 degrees F minimum.
 - 2) Duct Averaging Accuracy: Plus/minus 0.50 degrees F minimum.
 - 3) Chilled Water Accuracy: Plus/minus 0.50 degrees F minimum.
 - 4) Range: Minus 40 degrees F through 220 degrees F minimum.
 - b. Thermistor:
 - 1) Accuracy (All): Plus/minus 0.36 degrees F minimum.
 - 2) Range: Minus 25 degrees F through 122 degrees F minimum.
 - 3) Heat Dissipation Constant: 2.7 mW per degree C.
 - c. Temperature Transmitter:
 - 1) Accuracy: 0.10 degree F minimum or plus/minus 0.20 percent of span.
 - 2) Output: 4 to 20 mA.
 - d. Sensing Range:
 - 1) Provide limited range sensors if required to sense the range expected for a respective point.
 - e. Outside Air Sensors: Watertight inlet fitting shielded from direct rays of the sun.
 - f. Immersion Temperature Sensors: A sensor encased in a corrosion-resistant probe with an indoor junction box service entry body.
 - g. Room Temperature Sensors:
 - 1) Provide Honeywell model TR21
 - 2) Construct for surface or wall box mounting.
 - h. Room Temperature Sensors with local dial adjustment:

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- 1) Provide Honeywell model TR22
 - 2) Construct for surface or wall box mounting.
 - 3) Provide the following:
 - (a) Setpoint adjustment knob.
 - i. Room Temperature Sensors with local dial adjustment and override button
 - 1) Provide Honeywell model TR23
 - 2) Construct for surface or wall box.
 - 3) Provide the following:
 - (a) Momentary override request push button for activation of after-hours operation.
 - (b) Setpoint adjustment knob.
 - j. Temperature Averaging Elements:
 - 1) Use on duct sensors for ductwork 10 sq ft or larger.
- B. Humidity Sensors:
1. Wall Mounted Sensor: Voltage type encased in a plastic housing.
 - a. Input Power, Voltage Type: Class 2; 12-30 VDC/24 VAC, 15mA max. or 24 VAC plus/minus 10 percent 50/60 Hz
 - b. Output Voltage Type: 0-10 V observed polarity observed polarity.
 - c. Humidity:
 - 1) HS Element: Digitally profiled thin-film capacitive.
 - 2) Accuracy 2 percent at 10 to 80 percent relative humidity at 77 degrees F, multi-point calibration, NIST traceable.
 - 3) Scaling: 0 to 100 percent RH.
 - d. Hysteresis: 1.5 percent typical.
 - e. Linearity: Included in accuracy specification.
 - f. Stability: Plus/minus 1 percent at 68 degrees F (20 degrees C) annually, for two years.
- C. Static Pressure (Air Pressure) Sensors:
1. Unidirectional with ranges not exceeding 150 percent of maximum expected input.
 2. Temperature compensate with typical thermal error or 0.06 percent of full scale in temperature range of 40 to 100 degrees F.
 3. Accuracy: One percent of full scale with repeatability 0.3 percent.
 4. Output: 0 to 5 vdc with power at 12 to 28 vdc.
- D. Equipment Operation (Current) Sensors:
1. Status Inputs for Fans: Differential pressure switch with adjustable range of 0 to 5 inches wg.
 2. Status Inputs for Pumps: Differential pressure switch piped across pump with adjustable pressure differential range of 8 to 60 psi.
 3. Status Inputs for Electric Motors: Current sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.
- E. Carbon Dioxide Sensors, Wall:
1. General: Provide non-dispersive infrared (NDIR), diffusion sampling CO2 sensors with integral transducers and linear output.
 2. Air Temperature: Range of 32 to 122 degrees F.
 3. Relative Humidity: Range of 0 to 95 percent (non-condensing).
 4. Power Input: Class 2; 12 to 30VDC or 24VAC 50/60 Hz; 100mA max.
 5. Calibration Characteristics:
 - a. Automatically compensating algorithm for sensor drift due to sensor degradation.
 - b. Maximum Drift: 2 percent.
 - c. User calibratable with a minimum calibration interval of 5 years.
 6. Construction:
 - a. Sensor Chamber: Non-corrosive material for neutral effect on carbon dioxide sample.
-

- b. Provide duct mounted sensors with duct probe designed to protect sensing element from dust accumulation and mechanical damage.
 - c. Housing: High impact plastic.
- F. Occupancy Sensors, Ceiling:
 - 1. Manufacturer: Sensor Switch Inc; CM series.
 - 2. 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.
 - 3. Sensor Technology:
 - a. Passive Infrared Occupancy Sensors: Designed to detect occupancy using passive infrared technologies.
 - 4. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
 - 5. 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.
 - 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. Sensitivity: Field adjustable.
 - 9. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
 - 10. Isolated Relay for Low Voltage Occupancy Sensors: SPDT dry contacts, ratings as required for interface with system indicated.

2.07 TRANSMITTERS

- A. Building Static Pressure Transmitters:
 - 1. One pipe, differential type with temperature compensation, scale range 0.01 to 6.0 inch wg positive or negative, and sensitivity of 0.0005 inch wg. Transmit electronic signal to receiver with matching scale range.
- B. Pressure Transmitters:
 - 1. One pipe direct acting indicating type for liquid service, range suitable for system, proportional electronic output.
 - a. Accuracy (including non-linearity and hysteresis): $\pm 0.5\%$ FS
 - b. Compensated Temperature Range: 32°-150° F
 - c. Temperature Effect (over compensated range): 0.03%/°F
 - d. Output: 4-20 MA
 - e. Load Impedance (smallest maximum acceptable): 600 W Minimum
 - f. Operating Temperature: 0°-175° F
 - g. Hysteresis: 0.75% of span
- C. Air Pressure Transmitters:
 - 1. Provide dry media differential pressure transducers to monitor duct and room pressure.
 - a. Media Compatibility: Dry air.
 - b. Input Power: Class 2; 12 to 30 VDC; 2-wire: 20 mA max.
 - c. Output: Field selectable, 2-wire, loop-powered 4 to 20 mA (DC only, clipped and capped).
 - d. Accuracy: Plus/minus 1 percent f.s. (full scale) of selected range (combined linearity & hysteresis).

PART 3 - EXECUTION**3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that systems are ready to receive work.
- C. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check and verify location of thermostats, humidistats, and exposed control sensors with plans and room details before installation. Locate 42 inches above floor. Align with lighting switches. Refer to Section 26 27 26.
- C. Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.
- D. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.
- E. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.
- F. Provide conduit and electrical wiring in accordance with Section 26 05 83. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

END OF SECTION

SECTION 23 09 23
DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. System description.
- B. Networks,
- C. BACnet Requirements.
- D. Operator interface.
- E. Controllers.
- F. Power supplies and line filtering.
- G. System software.
- H. Controller software.

1.02 RELATED REQUIREMENTS

- A. Section 23 09 13 - Instrumentation and Control Devices for HVAC.
- B. Section 23 09 93 - Sequence of Operations for HVAC Controls.
- C. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks 2020, with Errata (2023).
- B. MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests 2019h.
- C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL (DIR) - Online Certifications Directory Current Edition.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
 - B. Product Data: Provide data for each system component and software module.
 - C. Shop Drawings:
 - 1. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.
 - 2. List connected data points, including connected control unit and input device.
 - 3. Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations. Provide demonstration digital media containing graphics.
 - 4. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
 - 5. Indicate description and sequence of operation of operating, user, and application software.
 - D. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
 - 1. Revise shop drawings to reflect actual installation and operating sequences.
 - E. Operation and Maintenance Data:
 - 1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
 - 2. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
 - 3. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
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- F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience.
- D. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for purpose specified and indicated.

1.06 WARRANTY

- A. Provide five year manufacturer's warranty for field programmable micro-processor based units.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Honeywell International, Inc. Niagara n4
 - 1. Building Automation Solutions. 608-453-3131. 2217 Industrial Drive, Monona WI 53713.
- B. Substitutions: None.

2.02 SYSTEM DESCRIPTION

- A. New facility DDC system to be integrated with City of Madison centralized management system.
- B. Automatic temperature control field monitoring and control system using field programmable micro-processor based units.
- C. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.
- D. System to be modular in nature, and shall permit expansion of both capacity and functionality through addition of sensors, actuators, controllers, and operator devices.
- E. Include computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.
- F. Controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan coils, and the like when directly connected to the control units. Individual terminal unit control is specified in Section 23 09 13.
- G. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.
- H. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.
- I. Failure of any single component or network connection shall not interrupt execution of control strategies at other operational devices.

2.03 NETWORKS

- A. The Local Area Network (LAN) shall be a 100 megabits/sec Ethernet network supporting BACnet, Java, XML, HTTP, and SOAP. Provide support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server.
- B. Local area network minimum physical and media access requirements:
 - 1. Ethernet; IEEE Standard 802.3.
 - 2. Cable; 100 Base-T, UTP-8 wire, Category 6

3. Minimum throughput; 100 Mbps
- C. Communication conduits shall not be installed closer than six feet from 110VAC or higher transformers or run parallel within six feet of electrical high power cables. Route the cable as far from interference generating devices as possible. Where communication wire must cross 110VAC or higher wire, it must do so at right angles.
- D. Ground all shields (earth ground) at one point only to eliminate ground loops. Provide all shield grounding at the controller location, with the shield at the sensor/device end of the applicable wire being left long and "safed" off in an appropriate manner.
- E. There shall be no power wiring in excess of 30 VAC rms run in conduit with communications wiring. In cases where signal wiring is run in conduit with communication wiring, run all communication wiring and signal wiring using separate twisted pairs (24awg) in accordance with the manufacturer's wiring practices
- F. Remote Network Access:
 1. Provide access to the LAN from a remote location via the Internet. The Owner shall provide a connection to the Internet to enable this access via high speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's intranet to a corporate server providing access to an Internet Service Provider (ISP). Customer agrees to pay monthly access charges for connection and ISP.

2.04 BACNET REQUIREMENTS

- A. BACnet Of the highest level network communications will utilize BACnet/IP over Ethernet and field level communications shall utilize BACnet MSTP. No other communication protocol is acceptable.
- B. All controllers shall provide a Protocol Implementation Conformance Statement (PICS) and BACnet Interoperability Building Blocks (BIBB"s) as required by the American National Standards Institute / American Society Of Heating Refrigerating And Air Conditioning Engineers (ANSI/ASHRAE). Standard 135, BACnet protocol.
- C. In general all devices should support the following:
 1. Segmentation Capability
 2. Segmentation Request Supported
 3. Segmentation Response Supported
 4. Standard Object Type Supported
 - a. Analog Input
 - b. Analog Output
 - c. Binary Input
 - d. Binary Output
 - e. Binary Value
 - f. Calendar
 - g. Device
 - h. Event Enrollment
 - i. Group
 - j. Multistate Input
 - k. Multistate Output
 - l. Multistate Value
 - m. Notification Class
 - n. Schedule
 5. Character Sets Supported
 - a. ANSI X3.4
 - b. ISO 10646 Universal Character Set-2
- D. All highest level networked supervisory devices shall support the following:
 1. Data Link Layer Option

- a. BASnew Internet Protocol (IP) (Annex J)
2. Networking Options.
3. BASnet/IP Broadcast Management Device (BBDM)

2.05 OPERATOR INTERFACE

- A. Provide an HTML based browser interface for accessing DDC system. Include hardware and software to provide an Ethernet twisted pair connection to owners local or wide area network (LAN or WAN) that can be used to access DDC system through a standard Internet browser.
- B. Provide information to owners't IT staff to facilitate connection through owner's LAN/WAN
- C. At a minimum, this interface shall be capable of all functions described under this specification.

2.06 CONTROLLERS

- A. Building Controllers:
 1. General:
 - a. Manage global strategies by one or more, independent, standalone, microprocessor based controllers.
 - b. Provide sufficient memory to support controller's operating system, database, and programming requirements.
 - c. Share data between networked controllers.
 - d. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
 - e. Utilize real-time clock for scheduling.
 - f. Continuously check processor status and memory circuits for abnormal operation.
 - g. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
 - h. Communication with other network devices to be based on assigned protocol.
 2. Communication:
 - a. Controller to reside on a BACnet network using ISO 8802-3 (ETHERNET) Data Link/Physical layer protocol.
 - b. Perform routing when connected to a network of custom application and application specific controllers.
 - c. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
 3. Anticipated Environmental Ambient Conditions:
 - a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within waterproof enclosures.
 - 2) Rated for operation at 40 to 150 degrees F.
 - b. Conditioned Space:
 - 1) Mount within dustproof enclosures.
 - 2) Rated for operation at 32 to 120 degrees F.
 4. Provisions for Serviceability:
 - a. Diagnostic LEDs for power, communication, and processor.
 - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
 5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
 6. Power and Noise Immunity:
 - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
 - b. Perform orderly shutdown below 80 percent of nominal voltage.
 - c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

B. Custom Application Controller:

1. General:
 - a. Provide sufficient memory to support controller's operating system, database, and programming requirements.
 - b. Share data between networked, microprocessor based controllers.
 - c. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
 - d. Utilize real-time clock for scheduling.
 - e. Continuously check processor status and memory circuits for abnormal operation.
 - f. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
 - g. Communication with other network devices to be based on assigned protocol.
2. Communication:
 - a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
 - b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
3. Anticipated Environmental Ambient Conditions:
 - a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within waterproof enclosures.
 - 2) Rated for operation at 40 to 150 degrees F.
 - b. Conditioned Space:
 - 1) Mount within dustproof enclosures.
 - 2) Rated for operation at 32 to 120 degrees F.
4. Provisions for Serviceability:
 - a. Diagnostic LED's for power, communication, and processor.
 - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
6. Power and Noise Immunity:
 - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
 - b. Perform orderly shutdown below 80 percent of nominal voltage.
 - c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

C. Application Specific Controllers:

1. General:
 - a. Not fully user programmable, microprocessor based controllers dedicated to control specific equipment.
 - b. Customized for operation within the confines of equipment served.
 - c. Communication with other network devices to be based on assigned protocol.
 2. Communication:
 - a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
 - b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
 3. Anticipated Environmental Ambient Conditions:
 - a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within waterproof enclosures.
 - 2) Rated for operation at 40 to 150 degrees F.
 - b. Conditioned Space:
 - 1) Mount within dustproof enclosures.
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- 2) Rated for operation at 32 to 120 degrees F.
 - 4. Provisions for Serviceability:
 - a. Diagnostic LEDs for power, communication, and processor.
 - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
 - 5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
 - 6. Power and Noise Immunity:
 - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
 - b. Perform orderly shutdown below 80 percent of nominal voltage.
 - c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 feet.
 - D. Input/Output Interface:
 - 1. Hardwired inputs and outputs tie into the DDC system through building, custom application, or application specific controllers.
 - 2. All Input/Output Points:
 - a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
 - b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.
 - 3. Binary Inputs:
 - a. Allow monitoring of On/Off signals from remote devices.
 - b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.
 - c. Sense dry contact closure with power provided only by the controller.
 - 4. Pulse Accumulation Input Objects: Comply with all requirements of binary input objects and accept up to 10 pulses per second.
 - 5. Analog Inputs:
 - a. Allow for monitoring of low voltage 0 to 10 VDC, 4 to 20 mA current, or resistance signals (thermistor, RTD).
 - b. Compatible with and field configurable to commonly available sensing devices.
 - 6. Binary Outputs:
 - a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
 - b. Outputs provided with three position (On/Off/Auto) override switches.
 - c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
 - 7. Analog Outputs:
 - a. Monitoring signal provides a 0 to 10 VDC or a 4 to 20 mA output signal for end device control.
 - b. Provide status lights and two position (AUTO/MANUAL) switch for building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.
 - c. Drift to not exceed 0.4 percent of range per year.
 - 8. Tri State Outputs:
 - a. Coordinate two binary outputs to control three point, floating type, electronic actuators without feedback.
 - b. Limit the use of three point, floating devices to the following zone and terminal unit control applications:
 - c. Control algorithms run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.
 - 9. System Object Capacity:
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- a. System size to be expandable to twice the number of input output objects required by providing additional controllers, including associated devices and wiring.
- b. Hardware additions or software revisions for the installed operator interfaces are not to be required for future, system expansions.

2.07 POWER SUPPLIES AND LINE FILTERING

A. Power Supplies:

1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
2. Limit connected loads to 80 percent of rated capacity.
3. Match DC power supply to current output and voltage requirements.
4. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
7. Operational Ambient Conditions: 32 to 120 degrees F.
8. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD-810 for shock and vibration.
9. Line voltage units UL recognized and CSA approved.

B. Power Line Filtering:

1. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.
2. Minimum surge protection attributes:
 - a. Dielectric strength of 1000 volts minimum.
 - b. Response time of 10 nanoseconds or less.
 - c. Transverse mode noise attenuation of 65 dB or greater.
 - d. Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

2.08 SYSTEM SOFTWARE

A. Operating System:

1. Concurrent, multi-tasking capability.
 - a. Common Software Applications Supported: Microsoft Excel.
2. System Graphics:
 - a. Allow up to 10 graphic screens, simultaneously displayed for comparison and monitoring of system status.
 - b. Animation displayed by shifting image files based on object status.
 - c. Provide method for operator with password to perform the following:
 - 1) Move between, change size, and change location of graphic displays.
 - 2) Modify on-line.
 - 3) Add, delete, or change dynamic objects consisting of:
 - (a) Analog and binary values.
 - (b) Dynamic text.
 - (c) Static text.
 - (d) Animation files.
3. Custom Graphics Generation Package:
 - a. Create, modify, and save graphic files and visio format graphics in PCX formats.
 - b. HTML graphics to support web browser compatible formats.
 - c. Capture or convert graphics from AutoCAD.
4. Standard HVAC Graphics Library:
 - a. HVAC Equipment:
 - 1) Chillers.

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- 2) Air Handlers.
 - 3) Terminal HVAC Units.
 - 4) Fan Coil Units.
 - b. Ancillary Equipment:
 - 1) Fans.
 - 2) Pumps.
 - 3) Coils.
 - 4) Valves.
 - 5) Piping.
 - 6) Dampers.
 - 7) Ductwork.
 - B. Workstation System Applications:
 - 1. Automatic System Database Save and Restore Functions:
 - a. Current database copy of each Building Controller is automatically stored on hard disk.
 - b. Automatic update occurs upon change in any system panel.
 - c. In the event of database loss in any system panel, the first workstation to detect the loss automatically restores the database for that panel unless disabled by the operator.
 - 2. Manual System Database Save and Restore Functions by Operator with Password Clearance:
 - a. Save database from any system panel.
 - b. Clear a panel database.
 - c. Initiate a download of a specified database to any system panel.
 - 3. Software provided allows system configuration and future changes or additions by operators under proper password protection.
 - 4. On-line Help:
 - a. Context-sensitive system assists operator in operation and editing.
 - b. Available for all applications.
 - c. Relevant screen data provided for particular screen display.
 - d. Additional help available via hypertext.
 - 5. Security:
 - a. Operator log-on requires user name and password to view, edit, add, or delete data.
 - b. System security selectable for each operator.
 - c. System supervisor sets passwords and security levels for all other operators.
 - d. Operator passwords to restrict functions accessible to viewing and/or changing system applications, editor, and object.
 - e. Automatic, operator log-off results from keyboard or mouse inactivity during user-adjustable, time period.
 - f. All system security data stored in encrypted format.
 - 6. System Diagnostics:
 - a. Operations Automatically Monitored:
 - 1) Workstations.
 - 2) Printers.
 - 3) Modems.
 - 4) Network connections.
 - 5) Building management panels.
 - 6) Controllers.
 - b. Device failure is annunciated to the operator.
 - 7. Alarm Processing:
 - a. All system objects are configurable to "alarm in" and "alarm out" of normal state.
 - b. Configurable Objects:
 - 1) Alarm limits.
 - 2) Alarm limit differentials.
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- 3) States.
 - 4) Reactions for each object.
 8. Alarm Messages:
 - a. Descriptor: English language.
 - b. Recognizable Features:
 - 1) Source.
 - 2) Location.
 - 3) Nature.
 9. Configurable Alarm Reactions by Workstation and Time of Day:
 - a. Logging.
 - b. Printing.
 - c. Starting programs.
 - d. Displaying messages.
 - e. Dialing out to remote locations.
 - f. Paging.
 - g. Providing audible annunciation.
 - h. Displaying specific system graphics.
 10. Custom Trend Logs:
 - a. Definable for any data object in the system including interval, start time, and stop time.
 - b. Trend Data:
 - 1) Sampled and stored on the building controller panel.
 - 2) Archivable on hard disk.
 - 3) Retrievable for use in reports, spreadsheets and standard database programs.
 - 4) Archival on LAN accessible storage media including hard disk, tape, Raid array drive, and virtual cloud environment.
 - 5) Protected and encrypted format to prevent manipulation, or editing of historical data and event logs.
 11. Alarm and Event Log:
 - a. View all system alarms and change of states from any system location.
 - b. Events listed chronologically.
 - c. Operator with proper security acknowledges and clears alarms.
 - d. Alarms not cleared by operator are archived to the workstation hard disk.
 12. Object, Property Status and Control:
 - a. Provide a method to view, edit if applicable, the status of any object and property in the system.
 - b. Status Available by the Following Methods:
 - 1) Menu.
 - 2) Graphics.
 - 3) Custom Programs.
 13. Reports and Logs:
 - a. Reporting Package:
 - 1) Allows operator to select, modify, or create reports.
 - 2) Definable as to data content, format, interval, and date.
 - 3) Archivable to hard disk.
 - b. Real-time logs available by type or status such as alarm, lockout, normal, etc.
 - c. Stored on hard disk and readily accessible by standard software applications, including spreadsheets and word processing.
 - d. Set to be printed on operator command or specific time(s).
 14. Reports:
 - a. Standard:
 - 1) Objects with current values.
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- 2) Current alarms not locked out.
 - 3) Disabled and overridden objects, points and SNVTs.
 - 4) Objects in manual or automatic alarm lockout.
 - 5) Objects in alarm lockout currently in alarm.
 - 6) Logs:
 - (a) Alarm History.
 - (b) System messages.
 - (c) System events.
 - (d) Trends.
 - b. Custom:
 - 1) Daily.
 - 2) Weekly.
 - 3) Monthly.
 - 4) Annual.
 - 5) Time and date stamped.
 - 6) Title.
 - 7) Facility name.
 - c. Tenant Override:
 - 1) Monthly report showing total, requested, after-hours HVAC and lighting services on a daily basis for each tenant.
 - 2) Annual report showing override usage on a monthly basis.
 - d. Weather:
 - 1) Weather:
 - (a) Monthly showing minimum, maximum, average outdoor air temperature and heating/cooling degree-days for the month.
- C. Workstation Applications Editors:
- 1. Provide editing software for each system application at PC workstation.
 - 2. Downloaded application is executed at controller panel.
 - 3. Full screen editor for each application allows operator to view and change:
 - a. Configuration.
 - b. Name.
 - c. Control parameters.
 - d. Set-points.
 - 4. Scheduling:
 - a. Monthly calendar indicates schedules, holidays, and exceptions.
 - b. Allows several related objects to be scheduled and copied to other objects or dates.
 - c. Start and stop times adjustable from master schedule.
 - 5. Custom Application Programming:
 - a. Create, modify, debug, edit, compile, and download custom application programming during operation and without disruption of all other system applications.
 - b. Programming Features:
 - 1) English oriented language, based on BASIC, FORTRAN, C, or PASCAL syntax allowing for free form programming.
 - 2) Alternative language graphically based using appropriate function blocks suitable for all required functions and amenable to customizing or compounding.
 - 3) Insert, add, modify, and delete custom programming code that incorporates word processing features such as cut/paste and find/replace.
 - 4) Allows the development of independently, executing, program modules designed to enable and disable other modules.
 - 5) Debugging/simulation capability that displays intermediate values and/or results including syntax/execution error messages.
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- 6) Support for conditional statements (IF/THEN/ELSE/ELSE-F) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
- 7) Support for floating-point arithmetic utilizing plus, minus, divide, times, square root operators; including absolute value; minimum/maximum value from a list of values for mathematical functions.
- 8) Language consisting of resettable, predefined, variables representing time of day, day of the week, month of the year, date; and elapsed time in seconds, minutes, hours, and days where the variable values can be used in IF/THEN comparisons, calculations, programming statement logic, etc.
- 9) Language having predefined variables representing status and results of the system software enables, disables, and changes the set points of the controller software.

2.09 CONTROLLER SOFTWARE

- A. All applications reside and operate in the system controllers and editing of all applications occurs at the operator workstation.
- B. System Security:
 1. User access secured via user passwords and user names.
 2. Passwords restrict user to the objects, applications, and system functions as assigned by the system manager.
 3. User Log On/Log Off attempts are recorded.
 4. Automatic Log Off occurs following the last keystroke after a user defined delay time.
- C. Object or Object Group Scheduling:
 1. Weekly Schedules Based on Separate, Daily Schedules:
 - a. Include start, stop, optimal stop, and night economizer.
 - b. 10 events maximum per schedule.
 - c. Start/stop times adjustable for each group object.
 2. Exception Schedules:
 - a. Based on any day of the year.
 - b. Defined up to one year in advance.
 - c. Automatically discarded and replaced with standard schedule for that day of the week upon execution.
 3. Holiday or Special Schedules:
 - a. Capability to define up to 99 schedules.
 - b. Repeated annually.
 - c. Length of each period is operator defined.
- D. Provide standard application for equipment coordination and grouping based on function and location to be used for scheduling and other applications.
- E. Alarms:
 1. Binary object is set to alarm based on the operator specified state.
 2. Analog object to have high/low alarm limits.
 3. All alarming is capable of being automatically and manually disabled.
 4. Alarm Reporting:
 - a. Operator determines action to be taken for alarm event.
 - b. Alarms to be routed to appropriate workstation.
 - c. Reporting Options:
- F. Maintenance Management: System monitors equipment status and generates maintenance messages based upon user-designated run-time limits.
- G. Sequencing: Application software based upon specified sequences of operation in Section 23 09 93.
- H. PID Control Characteristics:

1. Direct or reverse action.
 2. Anti-windup.
 3. Calculated, time-varying, analog value, positions an output or stages a series of outputs.
 4. User selectable controlled variable, set-point, and PED gains.
- I. Staggered Start Application:
1. Prevents all controlled equipment from simultaneously restarting after power outage.
 2. Order of equipment startup is user selectable.
- J. Energy Calculations:
1. Accumulated instantaneous power or flow rates are converted to energy use data.
 2. Algorithm calculates a rolling average and allows window of time to be user specified in minute intervals.
 3. Algorithm calculates a fixed window average with a digital input signal from a utility meter defining the start of the window period that in turn synchronizes the fixed-window average with that used by the power company.
- K. Anti-Short Cycling:
1. All binary output objects protected from short-cycling.
 2. Allows minimum on-time and off-time to be selected.
- L. On-Off Control with Differential:
1. Algorithm allows binary output to be cycled based on a controlled variable and set-point.
 2. Algorithm to be direct-acting or reverse-acting incorporating an adjustable differential.
- M. Run-Time Totalization:
1. Totalize run-times for all binary input objects.
 2. Provides operator with capability to assign high run-time alarm.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that conditioned power supply is available to the control units and to the operator work station.
Verify that field end devices and wiring is installed prior to installation proceeding.

3.02 INSTALLATION

- A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
- B. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation. Refer to Section 23 09 93.
- C. Provide conduit and electrical wiring in accordance with Section 26 05 83. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.
- D. Line voltage wiring to power DDC controllers not provided by Division 26 contractor to be by this contractor.
- E. Provide uninterruptible power supplies were necessary to provide proper startup of equipment or to accomplish power restart control sequences specified.

3.03 MANUFACTURER'S FIELD SERVICES

- A. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
- B. Provide service engineer to instruct Owner's representative in operation of systems plant and equipment for 3 day period.

- C. Provide basic operator training for 2 persons on data display, alarm and status descriptors, requesting data, execution of commands and request of logs. Include a minimum of 40 hours dedicated instructor time. Provide training on site.

3.04 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate complete and operating system to Owner.

END OF SECTION

SECTION 23 09 34
VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Variable-frequency motor controllers for low-voltage (600 V and less) AC motor applications.
- B. Overcurrent protective devices for motor controllers, including overload relays.

1.02 RELATED REQUIREMENTS

- A. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- B. Section 23 05 53 - Identification for HVAC Piping and Equipment: Identification products and requirements.
- C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

1.03 REFERENCE STANDARDS

- A. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code) 1989 (Corrigendum 2019).
- B. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers 2016.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- D. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts 2008 (Reaffirmed 2020).
- E. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices 2017.
- F. NEMA ICS 6 - Industrial Control and Systems: Enclosures 1993 (Reaffirmed 2016).
- G. NEMA ICS 7 - Industrial Control and Systems: Adjustable-Speed Drives 2020.
- H. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable-Speed Drive Systems 2022.
- I. NEMA ICS 7.2 - Application Guide for AC Adjustable Speed Drive Systems 2021.
- J. NEMA ICS 61800-2 - Adjustable Speed Electrical Power Drive Systems, Part 2: General Requirements-Rating Specifications for Low Voltage Adjustable Frequency AC Power Drive Systems 2005.
- K. NEMA MG 1 - Motors and Generators 2021.
- L. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.
- M. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- N. UL 508A - Industrial Control Panels Current Edition, Including All Revisions.
- O. UL 61800-5-1 - Standard for Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety Requirements – Electrical, Thermal, and Energy (Ed. 2) Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.
- C. Shop Drawings: Indicate dimensions, voltage, controller sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
- D. Field quality control test reports.

- E. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
- F. Project Record Documents: Record actual installed locations of controllers and final equipment settings.
 - 1. Include nameplate data of actual installed motors and associated overload relay selections and settings.

1.05 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store in clean, dry space. Maintain factory wrapping or provide 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 internal components, enclosure, and finish.

1.07 FIELD CONDITIONS

- A. Maintain field conditions within required service conditions during and after installation.

1.08 WARRANTY

- A. Provide minimum 18 month manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Danfoss.
- B. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.02 VARIABLE-FREQUENCY MOTOR CONTROLLERS

- A. Provide variable-frequency motor control system consisting of required controller assemblies, operator interfaces, control power transformers, instrumentation and control wiring, sensors, accessories, system programming, etc. as necessary for complete operating system.
- B. Provide products listed, classified, and labeled as suitable for purpose intended.
- C. Variable-Frequency Motor Controller:
 - 1. Configuration: Packaged controller, nonbypass.
 - 2. Rectifier/Converter: Diode-based, 6-pulse type.
 - 3. Control Method: Vector; open-loop, without feedback.
 - 4. Filtering: Provide input/line reactor and output/load reactor.
- D. Controller Assemblies: Comply with NEMA ICS 7, NEMA ICS 7.1, and NEMA ICS 61800-2; list and label as complying with UL 61800-5-1 or UL 508A as applicable.
- E. Provide controllers selected for actual installed motors and coupled mechanical loads in accordance with NEMA ICS 7.2, NEMA MG 1 Part 30, and recommendations of manufacturers of both controller and load, where not in conflict with specified requirements; considerations include, but are not limited to:
 - 1. Motor type (e.g., induction, reluctance, and permanent magnet); consider NEMA MG 1 design letter or inverter duty rating for induction motors.
 - 2. Motor load type (e.g., constant torque, variable torque, and constant horsepower); consider duty cycle, impact loads, and high inertia loads.

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3. Motor nameplate data.
 4. Requirements for speed control range, speed regulation, and braking.
 5. Motor suitability for bypass starting method, where applicable.
- F. Devices on Load Side of Controller: Suitable for application across full controller output frequency range.
- G. Operating Requirements:
1. Input Voltage Tolerance: Plus/minus 10 percent of nominal.
 2. Input Frequency Tolerance: Plus/minus 5 percent of nominal.
 3. Efficiency: Minimum of 96 percent at full speed and load.
 4. Input Displacement Power Factor: Minimum of 0.96 throughout speed and load range.
 5. Overload Rating:
 - a. Variable Torque Loads: Minimum of 110 percent of nominal for 60 seconds.
 - b. Constant Torque Loads: Minimum of 150 percent of nominal for 60 seconds.
- H. Power Conversion System: Microprocessor-based, pulse width modulation type consisting of rectifier/converter, DC bus/link, and inverter.
1. Rectifier/Converter: Diode-based, 6-pulse type unless otherwise indicated.
- I. Control System:
1. Provide microprocessor-based control system for automatic control, monitoring, and protection of motors. Include sensors, wiring, and connections necessary for functions and status/alarm indications specified.
 2. Provide integral operator interface for controller programming, display of status/alarm indications, fault reset, and local control functions including motor run/stop, motor forward/reverse selection, motor speed increase/decrease, and local/remote control selection.
 3. Control Functions:
 - a. Control Method: Selectable vector and scalar/volts per hertz unless otherwise indicated.
 - 1) Scalar/Volts per Hertz Control: Provide IR compensation for improved low-speed torque.
 - 2) Vector Control: Provide selectable autotuning function.
 - b. Adjustable acceleration and deceleration time; linear and S-curve ramps; selectable coast to stop.
 - c. Selectable braking control; DC injection or flux braking.
 - d. Adjustable minimum/maximum speed limits.
 - e. Adjustable pulse width modulation switching carrier frequency.
 - f. Adjustable motor slip compensation.
 - g. Selectable autorestart after noncritical fault; programmable number of time delay between restart attempts.
 4. Status Indications:
 - a. Motor run/stop status.
 - b. Motor forward/reverse status.
 - c. Local/remote control status.
 - d. Output voltage.
 - e. Output current.
 - f. Output frequency.
 - g. DC bus voltage.
 - h. Motor speed.
 5. Protective Functions/Alarm Indications:
 - a. Overcurrent.
 - b. Motor overload.
 - c. Undervoltage.
 - d. Overvoltage.
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- e. Controller overtemperature.
 - f. Input/output phase loss.
 - g. Output short circuit protection.
 - h. Output ground fault protection.
6. Inputs:
- a. Digital Input(s): Three.
 - b. Analog Input(s): Two.
7. Outputs:
- a. Analog Output(s): One.
 - b. Relay Output(s): Two.
8. Communications: Compatible with connected systems. Provide accessories necessary for proper interface.
- a. Serial Communications: RS-485; support for BACnet MS/TP protocol.
 - b. Ethernet Communications: Support for Modbus TCP and BACnet IP protocol.
 - c. Remote Monitoring Capabilities:
 - 1) Motor run/stop status.
 - 2) Hand-off-auto status.
 - 3) Fault information.
 - 4) Discrete input/output status.
 - 5) Analog input/output values.
 - d. Remote Control Capabilities:
 - 1) Motor run/stop command.
 - 2) Hand-off-auto selection.
 - 3) Speed adjustment.
 - 4) Fault reset.
9. Features:
- a. Password-protected security access.
 - b. Event log.
- J. Power Conditioning/Filtering:
- 1. Provide DC link choke or input/line reactor for each controller unless otherwise indicated or required.
 - 2. Provide LCL filter for controllers with IGBT-based active front end rectifier/converter.
 - 3. Provide input surge protection.
 - 4. Provide where indicated:
 - a. Input/line reactor.
 - b. Input tuned passive filter.
 - c. Output/load reactor.
 - d. Output dV/dt filter.
 - e. Output sine wave filter.
 - 5. Long Motor Leads:
 - a. Motor Leads Over 300 Feet: Provide output/load reactor.
 - b. Motor Leads Over 120 Feet: Provide output dV/dt filter.
 - 6. Reactor Impedance: 3 percent, unless otherwise indicated or required.
- K. Packaged Controllers: Controllers factory-mounted in separate enclosure with externally operable disconnect and specified accessories.
- 1. Disconnects: Circuit breaker or disconnect switch type.
 - a. Disconnect Switches: Fusible type or nonfusible type with separate input fuses.
 - b. Provide externally operable handle with means for locking in OFF position. Provide safety interlock to prevent opening cover with disconnect in ON position with capability of overriding interlock for testing purposes.
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- c. Provide auxiliary interlock for disconnection of external control power sources where applicable.
- 2. Provide door-mounted remote operator interface.
- L. Service Conditions:
 - 1. Provide controllers and associated components suitable for operation under following service conditions without derating:
 - a. Altitude: Less than 3,300 feet.
 - b. Ambient Temperature: Between 32 degrees F and 104 degrees F.
 - 2. Provide controllers and associated components suitable for operation at indicated ratings under service conditions at installed location.
- M. Short Circuit Current Rating:
 - 1. Provide controllers with listed short circuit current rating not less than available fault current at installed location as indicated on drawings.
 - 2. Provide line/input reactors where specified by manufacturer for required short circuit current rating.
- N. Conductor Terminations: Suitable for use with conductors to be installed.
- O. Enclosures:
 - 1. Comply with NEMA ICS 6.
 - 2. NEMA 250 Environment Type or Equivalent IEC 60529 Rating: Unless otherwise indicated, as specified for following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1 or Type 12.
 - 3. Finish: Manufacturer's standard unless otherwise indicated.
 - 4. Cooling: Forced air or natural convection as determined by manufacturer.
- P. Instrument Transformers:
 - 1. Comply with IEEE C57.13.
 - 2. Select suitable ratio, burden, and accuracy as required for connected devices.
 - 3. Current Transformers: Connect secondaries to shorting terminal blocks.
 - 4. Potential Transformers: Include primary and secondary fuses with disconnecting means.
- Q. Interface with Other Work:
 - 1. Provide products compatible with other systems requiring interface with controllers.
 - 2. Interface with building automation system as specified in Section 23 09 23.
 - a. Capable of remote monitoring and control of controllers.

2.03 OVERCURRENT PROTECTIVE DEVICES

- A. Overload Relays:
 - 1. Provide overload relays and, where applicable, associated current elements/heaters selected for actual installed motor nameplate data, in accordance with manufacturer's recommendations and NFPA 70; include consideration for motor service factor and ambient temperature correction, where applicable.
 - 2. Comply with NEMA ICS 2.
 - 3. Inverse-Time Trip Class Rating: Class 20 unless otherwise indicated or required.
 - 4. Trip-free operation.
 - 5. Visible trip indication.
 - 6. Resettable:
 - a. Employ manual reset unless otherwise indicated.
 - b. Do not employ automatic reset with two-wire control.

2.04 ACCESSORIES

- A. Pilot Devices:
 - 1. Comply with NEMA ICS 5; heavy-duty type.

2. Pushbuttons: Unless otherwise indicated, provide momentary, nonilluminated type with flush button operator; normally open or normally closed as indicated or as required.
3. Selector Switches: Unless otherwise indicated, provide maintained, nonilluminated type with knob operator; number of switch positions as indicated or as required.
4. Indicating Lights: Push-to-test type unless otherwise indicated.
5. Provide LED lamp source for indicating lights and illuminated devices.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that ratings of controllers are consistent with indicated requirements.
- C. Verify that mounting surfaces are ready to accept controllers.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install in accordance with NEMA ICS 7.1 and manufacturer's instructions.
- C. Do not exceed manufacturer's recommended maximum cable length between controller and motor.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required support and attachment in accordance with Section 23 05 29.
- F. Install controllers plumb and level.
- G. Provide grounding and bonding in accordance with Section 26 05 26.
- H. Install field-installed devices, components, and accessories.
- I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- J. Set field-adjustable settings of controllers and associated components according to installed motor requirements, in accordance with recommendations of manufacturers of controller and load.

3.03 FIELD QUALITY CONTROL

- A. Provide services of manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's reports with submittals.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.17. Insulation-resistance test on control wiring listed as optional is not required.
- D. Test for proper interface with other systems.
- E. Correct deficiencies and replace damaged or defective controllers or associated components.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

- A. Clean dirt and debris from controller enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of controllers to Owner, and correct deficiencies or make adjustments as directed.
- B. Training: Train Owner's personnel on operation, adjustment, and maintenance of controllers and associated 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: Manufacturer's authorized representative.
 - 4. Location: At project site.

3.07 PROTECTION

- A. Protect installed controllers from subsequent construction operations.

END OF SECTION

SECTION 23 09 93
SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other sections.
- B. General Control

1.02 RELATED REQUIREMENTS

- A. Section 23 09 13 - Instrumentation and Control Devices for HVAC.
- B. Section 23 09 23 - Direct-Digital Control System for HVAC.

1.03 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Sequence of Operation Documentation: Submit written sequence of operation for entire HVAC system and each piece of equipment.
 - 1. State each sequence in small segments and give each segment a unique number for referencing in Functional Test procedures; provide a complete description regardless of the completeness and clarity of the sequences specified in Contract Documents.
 - 2. Include initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
 - 3. For packaged controlled equipment, include manufacturer's furnished sequence of operation amplified as required to describe the relationship between the packaged controls and the control system, indicating which points are adjustable control points and which points are only monitored.
- C. Control System Diagrams: Submit graphic schematic of the control system showing each control component and each component controlled, monitored, or enabled.
 - 1. Label with settings, adjustable range of control and limits.
 - 2. Include flow diagrams for each control system, graphically depicting control logic.
 - 3. Include the system and component layout of all equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
 - 4. Include all monitoring, control and virtual points specified in elsewhere.
 - 5. Include a key to all abbreviations.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL CONTROL

- A. Setpoints:
 - 1. All setpoints indicated in control specification are to be adjustable.
 - 2. Setpoints shall be readily available to be modified in mechanical system software system summary (textual or graphic based) and under same software level as hardware points.
 - 3. Some less used setpoints may be provided on lower software level, if requested by user for clarity.
 - 4. Setpoints indicated are only specified as calculated starting point (or initial system operation). It is expected that setpoint adjustments and control loop tuning shall be required to provide optimum system operation based on requirements of building.

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5. Control contractor shall work with balancing contractor and Owner's Representative to provide final system setpoint adjustments and control loop tuning after system is in operation and building is in use.
 6. Document all final setpoints on record drawings. Any questions regarding intended operation of HVAC equipment and control systems shall be referred to HVAC design engineer through appropriate construction communication process.
 7. The following setpoints should be used as initial setpoints unless otherwise specified in individual control sequences:
 - a. VAV System Setpoints:
 - 1) Occupied/Standby Space Heating: 70 degrees F (adj)
 - 2) Unoccupied Space Heating: 60 degrees F (adj)
 - 3) Occupied/Standby Space Cooling: 74 degrees F (adj)
 - 4) Unoccupied Space Cooling: 80 degrees F (adj)
 - b. Terminal Heating (Electric Unit/Wall Heaters): 65 degrees F (adj)
 - c. IT Room Cooling: 70 degrees F (adj)
 - d. Library / Stacks Humidity Setpoints
 - 1) System Dehumidification Sequence Activation: 55% RH (adj)
- B. Anti-cycling:
1. When HVAC equipment or sequence is specified to be started and stopped by temperature, humidity, pressure setpoint or any other controlled variable, there shall be adjustable differential setpoint that shall be set to prevent short cycling of systems and equipment due to minor changes in controlled variable.
 2. Temperature differential setpoints shall be set at 2 degrees F and non-temperature setpoints shall be set at 10 percent of controlled range unless otherwise specified.
 3. Setpoints shall indicate at when process should be turned on.
 4. Heating and cooling differentials shall be set for above setpoint and will be used to turn process off.
 5. For example, economizer sequence called to switch at 68 degrees F would turn on at 68 degrees F and off at 70 degrees F since it is cooling function.
 6. Heating lockout setpoint of 50 degrees F would turn on heating control at 50 degrees F and off at 52 degrees F. Non-temperature differentials shall be set above setpoint if setpoint is indicating a minimum value or below setpoint if setpoint is indicating a maximum value.
 7. Provide minimum runtime timers for loads that are cycled to prevent over-cycling.
 8. Timers shall be set as specified or as needed to prevent damage or excessive wear to the equipment.
 9. Unless otherwise specified in individual control sequences, fans and pumps shall have a minimum runtime on timers of 15 minutes (adjustable) and off timers of 5 minutes (adjustable). Safeties shall override runtime timers.
- C. Deadbands:
1. Provide deadbands for all DDC control loops to prevent constant hunting of output signals to controlled devices.
 2. Deadbands shall be set to provide adequate control around setpoint as follows unless otherwise specified in individual control sequences:
 3. Temperature Control: ± 0.5 degrees F
 4. Humidity Control: ± 1 percent RH
 5. Airflow Control: ± 2 percent of total flow
 6. Static Pressure Control: ± 0.01 in. W.C.
- D. Alarms:
1. Provide all alarmed points with adjustable time delays to prevent nuisance tripping under normal operation and on equipment start-up.
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2. For commanded outputs that have status feedback, provide alarm that will indicate commanded output is not in its' commanded state.
 3. Provide alarms on all points as indicated on point charts. For existing campus automations systems, add or delete what is called on point charts for after consultation with Owner's Representative to provide consistent alarming throughout automation system.
- E. Equipment Start/Stop Failure States:
1. All start/stop points for equipment shall utilize normally open contacts unless called out specifically in individual control sequences.
- F. Lead/Lag Sequencing:
1. For sequences that call for lead/lag of equipment connected to building automation systems, lead device shall be able to be chosen through selectable day of week and time of day through building automation system.
 2. Coordinate with Owner's Representative for scheduling switchover and frequency.
 3. Unless otherwise directed, switchover shall occur at 10AM Tuesday and shall rotate lead device on weekly cycle rotating through all devices sequentially.
 4. For standalone lead/lag sequence controllers (non-DDC), lead device shall be selected by switch on panel face.
- G. Variable frequency Drive (VFD) Motor Run Status:
1. Use VFD programmable relay dry contact output provided with VFD to prove motor run status and detect belt loss or coupling break.
 2. If bypass contactor is provided with VFD, provide adjustable current switch and wire it in parallel with VFD output for proving motor status.
- H. VFD Bypass & Safety Interlocks:
1. VFD's equipped with bypass starters shall be interlocked so that start/stop and safety circuits that are called out for VFD operation shall be functional when VFD is indexed to bypass starter mode.
 2. Unless otherwise specified in sequence below, switch from inverter to bypass starter modes shall be through manual switch provided on VFD/bypass starter package.
- I. VFD Minimum Speed and Ramp Timers:
1. VFD start-up technician shall work with Temperature Control Contractor determine minimum speed required for motor controlled by VFD to provide cooling of motor as installed to prevent heat related problems.
 2. This minimum speed shall be set in VFD controller.
 3. VFD start-up technician shall work with DDC Temperature Control Contractor to set acceleration and deceleration timers in VFD controller at 30 seconds for motors less than 40 HP and 60 seconds for motors 40 HP and greater.
- J. Current Switch Setup:
1. When current switches are used for proving fan or pump status, they shall be set up so that they will detect belt or coupling loss by reduction in current draw on loss of coupled load.
 2. Current switch set up shall be redone by Control Contractor after balancer is complete.
- K. Damper Interlocks for Fans with Starters:
1. For fan systems with magnetic starters and shutoff dampers specified with end switches, damper interlock shall be hardwired in such a way that damper shall open if fan starter Hand / Off / Auto switch is in hand or in auto position and being called to start.
 2. After damper end switch has proven damper open, hardwire interlock from end switch to starter holding coil for fan shall cause fan to start.
 3. For fan systems that are ducted in parallel, see specific sequence for fan system on interlock requirements.
- L. Damper Interlocks for Fans with VFDs:
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1. For fan systems with VFD's and shutoff dampers specified with end switches, damper end switches shall be hardwire interlocked to safety circuit(s) of VFD to prevent fan from starting until damper is proven open.
 2. This interlock shall prevent fan from running in VFD or bypass (if provided) mode. Damper end switch shall also be monitored by DDC system.
 3. For fan systems that are ducted in parallel, see specific sequence for fan system on interlock requirements.
- M. Fan Interlocking:
1. Provide interlocks between supply and return or exhaust fan systems as scheduled on plans or called out in individual control sequences.
 2. If DDC controlled, interlocks shall be done through DDC start/stop points unless otherwise specified in individual control sequences.
 3. If not DDC controlled, interlocks shall be accomplished via hardwire interlocks between fan starters or VFD's.
- N. Thermostats and Sensors:
1. All devices and equipment including terminal units, specified to be controlled in control sequence by thermostat or sensor, shall be provided with thermostat or sensor, whether or not device is indicated on Drawings.
 2. Consult HVAC Design Engineer for thermostat or sensor location, if not indicated on Drawings.
- O. Original Equipment Manufacturer (OEM) Controller DDC Integration:
1. Provide DDC programming to define all equipment integral input/output points, setpoints, data points, calculations, etc. that are available through manufacturers communication interface.
 2. Consult with Owner's DDC operations personnel to determine if some of points should be omitted for clarity or lack of value.
 3. The following equipment shall be integrated into the DDC system:
 - a. Variable Frequency Drives
 - b. Heat Recovery Chiller
- P. Weekly Scheduling:
1. Provide scheduling of DDC terminal units in groups based on occupancy.
 2. Work with Owner's Representative to determine how many groups are required and which zones should be included.
 3. Individual terminal units shall be able to receive temporary schedules that will override group schedules.
 4. Temporary override buttons at zone sensor, where specified on point charts shall override scheduling to occupied mode.
 5. When groups that consist of more than 20 percent of terminal units are indexed to occupied, associated air handling unit shall start if not already running.
- Q. Refer to drawings for control sequences, points list, and schematics.

END OF SECTION

**SECTION 23 21 13
HYDRONIC PIPING****PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Hydronic system requirements.
- B. Heating water piping, above grade.
- C. Chilled water piping, above grade.
- D. Condenser water piping, buried.
- E. Condenser water piping, above grade.
- F. Equipment drains and overflows.
- G. Pipe hangers and supports.
- H. Unions, flanges, mechanical couplings, and dielectric connections.

1.02 RELATED REQUIREMENTS

- A. Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.
- B. Section 23 05 23 - General-Duty Valves for HVAC Piping.
- C. Section 23 05 48 - Vibration and Seismic Controls for HVAC.
- D. Section 23 05 53 - Identification for HVAC Piping and Equipment.
- E. Section 23 07 19 - HVAC Piping Insulation.
- F. Section 23 21 14 - Hydronic Specialties.
- G. Section 23 25 00 - HVAC Water Treatment: Pipe cleaning.

1.03 REFERENCE STANDARDS

- A. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300 2021.
- B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2021.
- C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings 2021.
- D. ASME B31.9 - Building Services Piping 2020.
- E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.
- F. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service 2019a.
- G. ASTM A183 - Standard Specification for Carbon Steel Track Bolts and Nuts 2014 (Reapproved 2020).
- H. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service 2023a.
- I. ASTM A536 - Standard Specification for Ductile Iron Castings 1984, with Editorial Revision (2019).
- J. ASTM B32 - Standard Specification for Solder Metal 2020.
- K. ASTM B88 - Standard Specification for Seamless Copper Water Tube 2022.
- L. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric) 2020.
- M. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications 2018.
- N. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers 1992 (Reapproved 2022).
- O. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing 2023.

- P. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems 2023.
- Q. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications 2007 (Reapproved 2019).
- R. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding 2019.
- S. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020, with Errata (2023).
- T. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems 2018.
- U. AWWA C606 - Grooved and Shouldered Joints 2022.
- V. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data:
 - 1. Include data on pipe materials, pipe fittings, valves, and accessories.
 - 2. Provide manufacturers catalog information.
- C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

1.05 QUALITY ASSURANCE

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

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 - PRODUCTS

2.01 HYDRONIC SYSTEM REQUIREMENTS

- A. Comply with ASME B31.9 and applicable federal, state, and local regulations.
- B. Piping: Provide piping, fittings, hangers, and supports as required, as indicated, and as follows:
 - 1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
 - 2. Use non-conducting dielectric connections whenever joining dissimilar metals.
 - 3. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
- C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges or unions to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.

2.02 HEATING WATER PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:
 - 1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
 - 2. Threaded Joints: ASME B16.3, malleable iron fittings.
- B. Steel Pipe Sizes 12 Inches and Greater: ASTM A53/A53M, 3/8 inch wall, black, using one of the following joint types:
 - 1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
 - 2. Threaded Joints: ASTM A536 ductile iron fittings.

- C. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn, using one of the following joint types:
 - 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
 - a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
 - b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.
 - 2. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.

2.03 CHILLED WATER PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black; using one of the following joint types:
 - 1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
 - 2. Threaded Joints: ASME B16.3, malleable iron fittings.
- B. Steel Pipe Sizes 12 Inches and Greater: ASTM A53/A53M, 3/8 inch wall, black; using one of the following joint types:
 - 1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
 - 2. Threaded Joints: ASTM A536 ductile iron fittings.
- C. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), hard drawn; using one of the following joint types:
 - 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22, solder wrought copper fittings.
 - a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
 - b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.
 - 2. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.

2.04 CONDENSER WATER PIPING, BURIED

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black with AWWA C105/A21.5 polyethylene jacket, or double layer, half-lapped polyethylene tape.
 - 1. Fittings: ASTM A234/A234M, wrought steel welding type with double layer, half-lapped polyethylene tape.
 - 2. Joints: Threaded for pipe 2 inches and under; AWS D1.1/D1.1M, welded for pipe over 2 inches.

2.05 CONDENSER WATER PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black.
 - 1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings with finish matching piping; AWS D1.1/D1.1M welded.
 - 2. Threaded Joints: ASME B16.3, malleable iron fittings with finish matching piping.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn; using one of the following joint types:
 - 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
 - a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
 - 2. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.

2.06 EQUIPMENT DRAINS AND OVERFLOWS

- A. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn; using one of the following joint types:
 - 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.

2.07 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.
 - 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inches: Carbon steel, adjustable swivel, split ring.
 - 3. Hangers for Cold Pipe Sizes 2 Inches and Greater: Carbon steel, adjustable, clevis.
 - 4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.

5. Hangers for Hot Pipe Sizes 6 Inches and Greater: Adjustable steel yoke, cast iron roll, double hanger.
6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Greater: Steel channels with welded spacers and hanger rods, cast iron roll.
8. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
9. Wall Support for Pipe Sizes 4 Inches and Greater: Welded steel bracket and wrought steel clamp.
10. Wall Support for Hot Pipe Sizes 6 Inches and Greater: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
11. Vertical Support: Steel riser clamp.
12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
14. Floor Support for Hot Pipe Sizes 6 Inches and Greater: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
16. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
17. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.08 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

- A. Unions for Pipe 2 Inches and Less:
 1. Ferrous Piping: 150 psig malleable iron, threaded.
 2. Copper Pipe: Bronze, soldered joints.
- B. Flanges for Pipe 2 Inches and Greater:
 1. Ferrous Piping: 150 psig forged steel, slip-on.
 2. Copper Piping: Bronze.
 3. Gaskets: 1/16 inch thick, preformed neoprene.
- C. Dielectric Connections:
 1. Waterways:
 - a. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
 - b. Dry insulation barrier able to withstand 600-volt breakdown test.
 - c. Construct of galvanized steel with threaded end connections to match connecting piping.
 - d. Suitable for the required operating pressures and temperatures.
 2. Flanges:
 - a. Dielectric flanges with same pressure ratings as standard flanges.
 - b. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
 - c. Dry insulation barrier able to withstand 600-volt breakdown test.
 - d. Construct of galvanized steel with threaded end connections to match connecting piping.
 - e. Suitable for the required operating pressures and temperatures.
 3. Unions:
 - a. 1/2 to 1 Inches: Brass solder to galvanized FPT.
 - b. 1/2 to 2 Inches: Brass solder to galvanized FPT.
 - c. 1/2 to 1 Inches: Brass to galvanized FPT or FIP (Female Iron Pipe).
 - d. 3/4 to 1/2 Inch Reducer: Brass solder to galvanized FPT.
 - e. Service: 250 psi, minus 20 to 180 deg F.

PART 3 - EXECUTION**3.01 PREPARATION**

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment using jointing system specified.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- E. After completion, fill, clean, and treat systems. See Section 23 25 00 for additional requirements.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and to avoid interference with use of space.
- D. Group piping whenever practical at common elevations.
- E. Sleeve pipe passing through partitions, walls, and floors.
- F. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.
- G. Slope piping and arrange to drain at low points.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 23 05 16.
- I. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
 - 2. Support horizontal piping as scheduled.
 - 3. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
 - 4. Place hangers within 12 inches of each horizontal elbow.
 - 5. Use hangers with 1-1/2 inches minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 - 7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 8. Provide copper plated hangers and supports for copper piping.
 - 9. Prime coat exposed steel hangers and supports. See Section 09 9123. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.03 SCHEDULES

- A. Hanger Spacing for Copper Tubing.
 - 1. 1/2 Inch and 3/4 inch: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 - 2. 1 Inch: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 - 3. 1-1/2 Inches and 2 Inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 4. 2-1/2 Inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 5. 3 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 6. 4 Inches: Maximum span, 12 feet; minimum rod size, 1/2 inch.
- B. Hanger Spacing for Steel Piping.
 - 1. 1/2 Inch, 3/4 Inch, and 1 Inch: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - 2. 1-1/4 Inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 3. 1-1/2 Inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 4. 2 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.

5. 2-1/2 Inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. 3 Inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. 4 Inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.

END OF SECTION

**SECTION 23 21 13.33
GROUND-LOOP HEAT-PUMP PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Ground-coupled heat exchanger and connections to building piping system, serving:

1.02 RELATED REQUIREMENTS

- A. Section 23 21 13 - Hydronic Piping: Building heating piping system.

1.03 REFERENCE STANDARDS

- A. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing 2020.
- B. ASTM D2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products 2022.
- C. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter 2022.
- D. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing 2016.
- E. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials 2021.
- F. ASTM F714 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter 2022.
- G. ASTM F1055 - Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing 2016a (Reapproved 2022).
- H. IGSHPA (GROUT) - Grouting Procedures for GHP Systems; International Ground Source Heat Pump Association 1991.
- I. PPI TR-4 - PPI HSB Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe 2021.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data, Polyethylene Piping: Provide manufacturer's data for piping and pipe fittings, showing compliance with specified requirements.
 - 1. Provide manufacturer's recommendations for fusion jointing.
 - 2. Include certification of long term hydrostatic basis, or test reports.
- C. Product Data, Heat Exchange Fluid: Provide data showing compliance with specified requirements.
 - 1. Provide manufacturer's Material Data Safety Sheets.
- D. Product Data, Grout and Slurry: Provide information on thermal conductivity of proposed materials.
- E. Shop Drawings: Show complete piping layout, water table, water level, depths of excavation, final depths of piping, backfill placement, point of entrance to building, point of connection to equipment, test point locations, and fittings used for all joints and connections.
- F. Test Reports, Piping: Indicate test method and results of hydrostatic pressure tests.
- G. Record Documents: Record actual locations of all underground piping installed relative to Owner's permanent structure on same property.
- H. Operation and Maintenance Data: Provide procedures for pressurizing, charging, and isolation for equipment replacement.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years of documented experience and accredited by IGSHPA.
- B. Heat Fusion Technician Certification: IGSHPA training and certification, certified within three years from the date of project commencement.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver piping and fittings to project site in shipping containers with labeling in place.
 - 1. Verify that labels on piping indicate manufacturer's name, pipe or tube size, and PE cell classification.
 - 2. Verify that piping complies with specifications and is undamaged.
- B. Deliver chemicals for heat exchange fluid to project site in unopened shipping containers with labeling in place; comply with local and state regulations.
- C. Protect from weather, humidity and temperature variations, dirt and dust, and other environmental contaminants.
- D. Store piping capped or plugged until time of installation.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Pipe: High density polyethylene pipe, type PE4710 with minimum ASTM D3350 cell classification of PE345364C.
 - 1. Pipe Used in Vertical Bore Applications: Comply with ASTM D3035 with minimum working pressure rating of 160 psi.
 - 2. Other Pipe of 3 Inches Diameter and Larger: Comply with ASTM D3035 or ASTM F714, with minimum working pressure rating of 100 psi.
 - 3. Other Pipe 1.25 Inches But Less Than 3 Inches In Diameter (Nominal): Comply with ASTM D3035 with minimum working pressure rating of 110 psi.
 - 4. Other Pipe Less Than 1.25 Inches in Diameter (Nominal): Comply with ASTM D3035 with minimum working pressure rating of 160 psi.
 - 5. Long Term Hydrostatic Design Basis: 1600 psi at 73 degrees F, when tested in accordance with ASTM D2837; appropriate listing in current edition of PPI TR-4 will constitute evidence of compliance with this requirement; otherwise, submit independent test results.
 - 6. Joints and Fittings: Polyethylene of same type as pipe, of sizes and types suitable for the pipe being used; use only heat fusion or stab-type mechanical fittings that are quality controlled to provide a leak-free union between piping ends that is stronger than the piping itself. Do not use other barbed fittings or hose clamps.
 - a. Butt Fusion Fittings: Comply with ASTM D3261.
 - b. Socket Type Fittings: Comply with ASTM D2683.
 - c. Where threaded fittings must be used for connection to equipment or dissimilar piping, use fittings and thread sealant compatible and effective with antifreeze used.
- B. Heat Exchange Fluid: Water and antifreeze solution, 30 percent propylene glycol by weight.
- C. Detectable Underground Tape: Magnetic detectable conductor in 2 inch wide rot-resistant plastic tape or mesh, brightly colored, imprinted with "Water Line" in large letters.
- D. Backfill for Vertical Boreholes: Thermally Enhanced Bentonite. Refer to drawings for performance information.

PART 3 EXECUTION**3.01 EXAMINATION AND PREPARATION**

- A. Perform all work in accordance with Wisconsin Department of Natural Resources Requirements and Chapter NR 812 of the Wisconsin Administrative Code.

- B. Obtain required permits from the Wisconsin Department of Natural Resources.
- C. Verify location of existing structures and utilities prior to excavation.
- D. Verify soil composition and rock depth, if any, before beginning excavation.
- E. Protect adjacent structures from the effects of excavation.
- F. Verify that layout dimensions are correct and that available land is sufficient for design.
- G. Notify Engineer of unsatisfactory conditions.
- H. Do not proceed with installation until unsatisfactory conditions have been corrected.
- I. Coordinate work with site grading, site backfilling, and foundation construction.

3.02 EXCAVATION

- A. Excavate in accordance with requirements of authorities having jurisdiction.
- B. Vertical Boreholes: Drill to depths as indicated on plans.
 - 1. Utilize only mud rotary recirculation drilling.
 - 2. Minimize over-drilling; fill over-drilled areas with backfill or excavated materials.
- C. Trenches: Excavate trenches for piping to lines and grades shown on drawings.
 - 1. Minimize over-excavation; fill over-excavated areas with backfill or excavated materials.
 - 2. Excavate to accommodate grade changes.
 - 3. Maintain trenches free of debris, material, and obstructions that may damage pipe.
 - 4. Piping: Assemble heat exchanger piping and test before backfilling.

3.03 POLYETHYLENE PIPING

- A. Join piping and fittings using heat fusion or electrofusion; do not use solvents, adhesives, or mechanical fittings.
- B. Provide flanges or unions to connect heat exchanger piping to equipment or piping of different type; locate all transitions between piping of different types inside the building or otherwise accessible (i.e. above grade).
- C. Keep dirt, water, and debris out of pipe assemblies; cap or plug open ends until connected to adjacent piping.
- D. Do not bend piping to shorter radius than recommended by pipe manufacturer; do not kink piping; use elbow or other fittings for sharp bends.
- E. Partially backfill radius bends in narrow trenches by hand to ensure that piping is properly supported and to prevent kinking.
- F. Test piping to be installed in boreholes after assembly but before installation in boreholes; re-cap tested assemblies before installation.
- G. Test piping to be installed in trenches after installation but before backfilling.
- H. Testing: Perform hydrostatic test on all piping; portions of assembled piping may be tested separately.
 - 1. Prior to testing, isolate piping from all connections to building systems.
 - 2. Flush all dirt and debris using potable water flowing at twice the normal operating flow rate for a minimum of four hours or until no dirt or debris is visible, whichever is longer.
 - 3. Plug or cap piping.
 - 4. Pressurize piping to 150 psi for 30 minutes and monitor.
 - 5. If there is any pressure loss or visible leakage, identify leak and repair in accordance with manufacturer's recommendations.
 - 6. Repeat test until there is no loss of pressure for the duration of the test.
- I. Where piping passes through foundation walls, provide sleeves sealed with non-hardening, waterproof material.

-
- J. After connection of piping to building systems and installation of equipment served by heat exchanger, fill piping with heat exchange fluid and pressurize.
1. Water Temperature of 70 to 90 degrees F: Pressurize to 20 to 30 psi, minimum.
 2. Water Temperature of 40 to 50 degrees F: Pressurize to 40 to 50 psi, minimum.
 3. If adequate flooding of circulating pump can be accomplished without pressurization and pump manufacturer approves, pressurization is not required.
 4. After pressurization, remove charging valve handles, or plug ports, whichever is applicable, and deliver handles to Owner.
 5. Install system label at charging valves, indicating:
 - a. Heat exchange fluid, including antifreeze type and concentration.
 - b. Service date.
 - c. Company name.
 - d. Company phone number and responsible person.

3.04 BACKFILLING

- A. Install in compliance with local authorities having jurisdiction.
- B. Vertical Boreholes: Backfill after pipe installation in accordance with IGSHPA (GROUT) - IGSHPA Grouting Procedures for GHP Systems.
- C. Trenches:
 1. Provide minimum 60 inch cover over piping.
 2. Provide 6" of bedding sand surrounding piping within trenches.
 3. Backfill trenches after pipe has been installed and tested, using fill free of rocks and other debris.
 4. Install detectable tape continuously 6 inches above top of all buried pipe.
 5. Backfill and compact using the procedures specified in Section 31 23 16.13.
 6. Backfill to original grades with sufficient overfill to allow for settlement.
- D. Protect piping from displacement.

3.05 CLEANING

- A. Leave adjacent paved areas broom clean.
- B. Clear debris, including excess backfill and excavated dirt and rock, from heat exchanger area.

3.06 PROTECTION

- A. Protect area during excavation from excess runoff and erosion.
- B. Protect pipe protrusions from damage until connections to building systems are installed.

END OF SECTION

SECTION 23 21 14 HYDRONIC SPECIALTIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Expansion tanks.
- B. Air vents.
- C. Air separators.
- D. Strainers.
- E. Suction diffusers.
- F. Pump connectors.
- G. Pressure-temperature test plugs.
- H. Balancing valves.
- I. Glycol system.

1.02 RELATED REQUIREMENTS

- A. Section 23 21 13 - Hydronic Piping.
- B. Section 23 25 00 - HVAC Water Treatment: Pipe cleaning.

1.03 REFERENCE STANDARDS

- A. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels 2023.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required 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 and model.
- C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- D. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.05 QUALITY ASSURANCE

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

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 - PRODUCTS

2.01 EXPANSION TANKS

- A. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, adjustable flexible EPDM diaphragm or bladder seal factory precharged to 12 psi, and steel support stand.

- B. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check backflow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.
- C. Manufacturers:
 - 1. Taco Comfort Solutions, Inc.
 - 2. Bell & Gossett; <https://www.xylem.com/en-us/brands/bell-gossett/>
 - 3. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.02 AIR VENTS

- A. Manual Type: Short vertical sections of 2-inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.
- 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. Cast iron body and cover, float, bronze pilot valve mechanism suitable for system operating temperature and pressure; with isolating valve.
- C. Manufacturers:
 - 1. Taco Comfort Solutions, Inc.
 - 2. Bell & Gossett; <https://www.xylem.com/en-us/brands/bell-gossett/>
 - 3. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.03 AIR SEPARATORS

- A. Coalescing Air/Dirt Separators:
 - 1. Tank: Fabricated steel tank with removable cover; tested and stamped in accordance with ASME BPVC-VIII-1; for operating pressure of 150 psi at maximum operating temperature of 270 degrees F; subject to requirements of application and manufacturer's standard maximum operating conditions.
 - 2. Coalescing Medium: Provide structured copper or stainless steel medium filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100 percent free air, 100 percent entrained air, and 99.6 percent dissolved air at the installed location.
 - 3. Air Vent: Integral float actuated air vent at top fitting of tank rated at 150 psi, threaded to top of separator.
 - 4. Inlet and Outlet Connections: Threaded for sizes 2 inch, NPS and smaller; Class 150 flanged connections for 2-1/2 inch, NPS and larger.
 - 5. Blowdown Connection: Threaded.
 - 6. Size: Match system flow capacity.
 - 7. Manufacturers:
 - a. Taco Comfort Solutions, Inc.
 - b. Bell & Gossett; <https://www.xylem.com/en-us/brands/bell-gossett/>
 - c. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.04 STRAINERS

- A. Size 2 inch and Under:
 - 1. Screwed brass or iron body for 175 psi working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
- B. Size 2-1/2 inch to 4 inch:
 - 1. Provide flanged iron body for 175 psi working pressure, Y pattern with 1/16 inch stainless steel perforated screen.
- C. Size 5 inch and Larger:
 - 1. Provide flanged iron body for 175 psi working pressure, basket pattern with 1/8 inch stainless steel perforated screen.
 - 2. Manufacturers:

- a. Watts
- b. Armstrong
- c. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.05 SUCTION DIFFUSERS

- A. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, rated for 175 psi working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable 5/32 inch mesh strainer to fit over cylinder strainer, 20 mesh startup screen, and permanent magnet located in flow stream and removable for cleaning.
- B. Accessories: Adjustable foot support, blowdown tapping in bottom, gauge tapping in side.
- C. Manufacturers:
 1. Taco Comfort Solutions, Inc.
 2. Bell & Gossett; <https://www.xylem.com/en-us/brands/bell-gossett/>
 3. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.06 PUMP CONNECTORS

- A. Flexible Connectors: Flanged, braided type with wetted components of stainless steel, sized to match piping.
 1. Maximum Operating Service: 150 psi at 120 degrees F.
 2. End Connections: Same as specified for pipe jointing.
 3. Provide necessary accessories including, but not limited to, swivel joints.
- B. Manufacturers:
 1. ASC Engineered Solutions
 2. The Metraflex Company
 3. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.07 PRESSURE-TEMPERATURE TEST PLUGS

- A. Construction: Brass body designed to receive temperature or pressure probe with removable protective cap, and Neoprene rated for minimum 200 degrees F.
- B. Application: Use extended length plugs to clear insulated piping.
- C. Manufacturers:
 1. Ferguson Enterprises Inc
 2. Peterson Equipment Company Inc
 3. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.08 BALANCING VALVES

- A. Size 2 inch 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 threaded, soldered, or sweat connections.
 2. Metal construction materials consist of bronze or brass.
 3. Non-metal construction materials consist of Teflon or EPDM.
- B. Size 2.5 inch and Larger:
 1. Provide plug, globe, or butterfly style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and flanged or weld end connections.
 2. Valve body construction materials consist of cast iron, carbon steel, or ductile iron.
 3. Internal components construction materials consist of brass, aluminum bronze, bronze, Teflon, EPDM, or NORYL.
- C. Manufacturers:
 1. IMI Hydronic Engineering
 2. Caleffi Hydronic Solutions
 3. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.09 GLYCOL SYSTEM

- A. Pump System:
 - 1. Storage: 50 gal polypropylene tank with bolt-removable hinged solid cover and enamel coated carbon steel tank-stand.
 - 2. Pump:
 - a. Thermally protected 1/3 hp motor at 115 to 120 VAC, single phase rated for indoor service.
 - b. Maximum Service Operation: 100 psi at 85 degrees F.
 - 3. Mechanical Accessories: System isolation valves, strainer, and pressure gauges.
 - 4. Control Panel:
 - a. Fused single-point system connection rated at 115 to 120 VAC, single phase.
 - b. Interface: Hand switches with indicating lights for ON, FAULT, and LOW LEVEL.
 - c. Pressure Switch: Panel-mounted and prewired for 10 psi cut-in and 40 psi cut-out, adjustable.
 - d. Low Level Cut-Off Switch: Prewired to shut-down unit upon activation. Tank-side mounted.
 - 5. Pressure Relief Valve: System-mounted brass valve tubed from pump discharge side into tank with adjustable setpoint between 20 psi and 150 psi.
- B. Glycol Solution:
 - 1. Water-based solution mix containing 25 percent propylene glycol by volume required for cooling or heating system operating temperature range.
 - 2. Cooling or heating System Operating Temperature Range: Between freezing and boiling points of 3 and 220 degrees F at 14.7 psia.
- C. Manufacturers:
 - 1. Wessels Company
 - 2. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions.
- B. Provide manual air vents at system high points and as indicated.
- C. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.
- D. Provide valved drain and hose connection on strainer blowdown connection.
- E. Support pump fittings with floor-mounted pipe and flange supports.
- F. Pipe relief valve outlets to nearest floor drain. Relief valves located in mechanical space to be piped back to glycol fill tank.
- 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. Clean and flush glycol system before adding glycol solution. Refer to Section 23 25 00.

END OF SECTION

**SECTION 23 21 23
HYDRONIC PUMPS****PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. In-line Circulator
- B. Vertical in-line pumps.

1.02 RELATED REQUIREMENTS

- A. Section 23 07 16 - HVAC Equipment Insulation.
- B. Section 23 07 19 - HVAC Piping Insulation.
- C. Section 23 21 13 - Hydronic Piping.
- D. Section 23 21 14 - Hydronic Specialties.

1.03 REFERENCE STANDARDS

- A. UL 778 - Standard for Motor-Operated Water Pumps Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required 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.

1.05 QUALITY ASSURANCE**PART 2 - PRODUCTS****2.01 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.
- C. Manufacturers:
 - 1. Taco Comfort Solutions, Inc.
 - 2. Bell & Gossett; <https://www.xylem.com/en-us/brands/bell-gossett/>
 - 3. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.02 IN-LINE CIRCULATOR

- A. Type: Direct drive in-line circulator with replaceable cartridge containing all moving parts for easy service and replacement.
- B. Casing: Cast Iron with flanged suction and discharge.
- C. Impeller: Non-metallic
- D. Shaft: Ceramic

2.03 VERTICAL IN-LINE PUMPS

- A. Type: Vertical, single stage, close coupled, radially or horizontally split casing, for in-line mounting, for 175 psi working pressure.
- B. Casing: Cast iron, with suction and discharge gauge port, casing wear ring, seal flush connection, drain plug, flanged suction and discharge.
- C. Impeller: Bronze, fully enclosed, keyed directly to motor shaft or extension.

- D. Shaft: Carbon steel with stainless steel impeller cap screw or nut and bronze sleeve.
- E. Seal: Mechanical seal, 225 degrees F maximum continuous operating temperature.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.02 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. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close-coupled or base-mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches and over.
- D. Provide line sized shut-off valve and strainer on pump suction, and line sized soft seat check valve and balancing valve on pump discharge.
- E. Provide air cock and drain connection on horizontal pump casings.
- F. Provide drains for bases and seals, piped to and discharging into floor drains.
- G. Check, align, and certify alignment of base-mounted pumps prior to start-up.
- H. Install close-coupled and base-mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place. Refer to Section 03 30 00.
- I. Lubricate pumps before start-up.
- J. Provide side-stream filtration system for closed loop systems. Install across pump with flow from pump discharge to pump suction from pump tapplings.

END OF SECTION

**SECTION 23 23 00
REFRIGERANT PIPING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Piping.
- B. Moisture and liquid indicators.
- C. Filter-driers.

1.02 RELATED REQUIREMENTS

- A. Section 23 07 16 - HVAC Equipment Insulation.

1.03 REFERENCE STANDARDS

- A. AHRI 710 (I-P) - Performance Rating of Liquid-Line Driers; 2009.
- B. AHRI 711 (SI) - Performance Rating of Liquid-Line Driers; 2009.
- C. AHRI 730 (I-P) - Flow Capacity Rating of Suction Line Filters and Suction Line Filter Driers; 2013 (Reapproved 2014).
- D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2022, with Addendum (2024).
- E. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- F. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2022.
- G. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2023.
- H. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide general assembly of specialties, including manufacturer's catalogue information. Provide manufacturer's catalog data including load capacity.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties in shipping containers with labeling in place.
- B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.
- C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 PRODUCTS**2.01 PIPING**

- A. Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed.
 - 1. Fittings: ASME B16.22 wrought copper.
 - 2. Joints: Braze, AWS A5.8M/A5.8 BCuP silver/phosphorus/copper alloy.

2.02 MOISTURE AND LIQUID INDICATORS

- A. Indicators: Single port type, UL listed, with copper or brass body, flared or soldered ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F (93 degrees C) and maximum working pressure of 500 psi (3450 kPa).

2.03 FILTER-DRIERS

- A. Performance:

1. Flow Capacity - Liquid Line: As indicated in schedule, minimum, rated in accordance with AHRI 710 (I-P).
 2. Flow Capacity - Suction Line: As indicated in schedule, minimum, rated in accordance with AHRI 730 (I-P).
 3. Pressure Drop: 2 psi (14 kPa), maximum, when operating at full connected evaporator capacity.
 4. Design Working Pressure: 350 psi (2410 kPa), minimum.
- B. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, activated charcoal, and filtration to 40 microns, with secondary filtration to 20 microns; of construction that will not pass into refrigerant lines.
- C. Construction: UL listed.
1. Connections: As specified for applicable pipe type.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain-end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and avoid interference with use of space.
- D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Pipe Hangers and Supports:
 1. Install in accordance with ASME B31.5.
 2. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
 3. Place hangers within 12 inches (300 mm) of each horizontal elbow.
 4. Provide copper plated hangers and supports for copper piping.
- G. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- H. Provide clearance for installation of insulation and access to valves and fittings.
- I. Flood piping system with nitrogen when brazing.
- J. Insulate piping and equipment.
- K. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.
- L. Fully charge completed system with refrigerant after testing.

3.03 FIELD QUALITY CONTROL

- A. Test refrigeration system in accordance with ASME B31.5.
- B. Pressure test system with dry nitrogen to 200 psi (1380 kPa). Perform final tests at 27 inches (92 kPa) vacuum and 200 psi (1380 kPa) using halide torch. Test and repair piping until no leakage.

END OF SECTION

**SECTION 23 25 00
HVAC WATER TREATMENT**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Materials.
 - 1. System cleaner.
 - 2. Closed system treatment (water).
- B. By-pass (pot) feeder.

1.02 REFERENCE STANDARDS

- A. UL (DIR) - Online Certifications Directory Current Edition.

1.03 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate system schematic, equipment locations, and controls schematics, electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Indicate placement of equipment in systems, piping configuration, and connection requirements.
- E. Project Record Documents: Record actual locations of equipment and piping, including sampling points and location of chemical injectors.
- F. Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience. Company shall have local representatives with water analysis laboratories and full time service personnel.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Comply with applicable codes for addition of non-potable chemicals to building mechanical systems and to public sewage systems.
- B. Comply with UL (DIR) requirements.
- C. Perform work in accordance with local health department regulations.
- D. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of installation.

2.02 MATERIALS

- A. System Cleaner:
 - 1. Manufacturers:
 - a. AmSolv-Amrep, Inc: www.amsolv.com/#sle.
 - b. GE Water & Process Technologies: www.gewater.com/#sle.
 - c. Nalco, an Ecolab Company: www.nalco.com/#sle.
 - d. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
 - 2. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products; sodiumtripoly phosphate and sodium molybdate.

3. Biocide chlorine release agents such as sodium hypochlorite or calcium hypochlorite or microbiocides such as quarternary ammonia compounds, tributyltin oxide, methylene bis (thiocyanate).
- B. Closed System Treatment (Water):
 1. Manufacturers:
 - a. AmSolv-Amrep, Inc: www.amsolv.com/#sle.
 - b. GE Water & Process Technologies: www.gewater.com/#sle.
 - c. Nalco, an Ecolab Company: www.nalco.com/#sle.
 - d. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
 2. Sequestering agent to reduce deposits and adjust pH; polyphosphate.
 3. Corrosion inhibitors; boron-nitrite, sodium nitrite and borax, sodium tolyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.
 4. Conductivity enhancers; phosphates or phosphonates.

2.03 BY-PASS (POT) FEEDER

- A. Manufacturers:
 1. Griswold Controls: www.griswoldcontrols.com/#sle.
 2. J. L. Wingert Company: www.jlwingert.com/#sle.
 3. Neptune, a brand of the Dover Company: www.neptune1.com/#sle.
 4. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. 2 quart quick opening cap for working pressure of 175 psi.

PART 3 EXECUTION

3.01 PREPARATION

- A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.
- B. Place terminal control valves in open position during cleaning.
- C. Verify that electric power is available and of the correct characteristics.

3.02 CLEANING SEQUENCE

- A. Concentration:
 1. As recommended by manufacturer.
- B. Hot Water Heating Systems:
 1. Apply heat while circulating, slowly raising temperature to 160 degrees F and maintain for 12 hours minimum.
 2. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water.
 3. Circulate for 6 hours at design temperatures, then drain.
 4. Refill with clean water and repeat until system cleaner is removed.
- C. Use neutralizer agents on recommendation of system cleaner supplier and approval of Architect.
- D. Flush open systems with clean water for one hour minimum. Drain completely and refill.
- E. Remove, clean, and replace strainer screens.
- F. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.04 CLOSED SYSTEM TREATMENT

- A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.

- B. Introduce closed system treatment through bypass feeder when required or indicated by test.

3.05 CLOSEOUT ACTIVITIES

- A. Training: Train Owner's personnel on operation and maintenance of chemical treatment system.
 - 1. Provide minimum of two hours of instruction for two people.
 - 2. Have operation and maintenance data prepared and available for review during training.
 - 3. Conduct training using actual equipment after treated system has been put into full operation.

END OF SECTION

**SECTION 23 31 00
HVAC DUCTS AND CASINGS**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Metal ductwork.
- B. Nonmetal ductwork.

1.02 RELATED REQUIREMENTS

- A. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.
- B. Section 23 07 13 - Duct Insulation: External insulation and duct liner.
- C. Section 23 33 00 - Air Duct Accessories.
- D. Section 23 36 00 - Air Terminal Units.
- E. Section 23 37 00 - Air Outlets and Inlets.

1.03 REFERENCE STANDARDS

- A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2023.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023c.
- E. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry 2018, with Editorial Revision (2020).
- F. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements 2017, with Editorial Revision (2020).
- G. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements 2023.
- H. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2024.
- I. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2020.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide data for duct materials.
- C. Shop Drawings: Indicate duct fittings, particulars such as gauges, sizes, welds, and configuration prior to start of work for 1" pressure class and higher systems.
- D. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.

1.06 FIELD CONDITIONS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 - PRODUCTS**2.01 DUCT ASSEMBLIES**

- A. Regulatory Requirements: Construct ductwork to comply with NFPA 90A standards.
- B. Ducts: Galvanized steel, unless otherwise indicated.
- C. Low Pressure Supply (Heating Systems): 2 inch wg pressure class, galvanized steel.
- D. Low Pressure Supply (System with Cooling Coils): 2 inch wg pressure class, galvanized steel.
- E. Medium and High Pressure Supply: 3 inch w.g. pressure class, galvanized steel.
- F. Return and Relief: 2 inch wg pressure class, galvanized steel.
- G. General Exhaust: 2 inch wg pressure class, galvanized steel.
- H. Outside Air Intake: 2 inch wg pressure class, galvanized steel.
- I. Transfer Air and Sound Boots: 1 inch wg pressure class, fibrous glass.

2.02 MATERIALS

- A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
- B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
 - 1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
 - 2. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
- C. Gasket Tape: Provide butyl rubber gasket tape for a flexible seal between transfer duct connector (TDC), transverse duct flange (TDF), applied flange connections, and angle rings connections.
- D. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
- E. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
 - 1. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 - 2. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
 - 3. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.

2.03 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.
- B. No variation of duct configuration or size permitted except by written permission. Size round duct installed in place of rectangular ducts in accordance with ASHRAE (FUND) Handbook - Fundamentals.
- C. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
- D. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.
- E. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
- F. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- G. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).

2.04 MANUFACTURED DUCTWORK AND FITTINGS

- A. Spiral Ducts: Round spiral lockseam duct with galvanized steel outer wall.
 - 1. Manufacture in accordance with SMACNA (DCS).
-

- B. Round Ducts: Round lockseam duct with galvanized steel outer wall.
 - 1. Manufacture in accordance with SMACNA (DCS).
- C. Flexible Ducts: Two-ply vinyl film supported by helically wound spring steel wire.
 - 1. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
 - 2. Pressure Rating: 10 inches wg positive and 1.0 inches wg negative.
 - 3. Maximum Velocity: 4000 fpm.
 - 4. Temperature Range: Minus 10 degrees F to 160 degrees F.
- D. Round Duct Connection System: Interlocking duct connection system in accordance with SMACNA (DCS).

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Install in accordance with manufacturer's instructions.
- C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- D. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- E. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- F. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- G. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.
- H. Use double nuts and lock washers on threaded rod supports.
- I. Connect terminal units to supply ducts directly or with one foot maximum length of flexible duct. Do not use flexible duct to change direction.
- J. Connect diffusers or light troffer boots to low pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.

END OF SECTION

**SECTION 23 33 00
AIR DUCT ACCESSORIES**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Air turning devices/extractors.
- B. Duct access doors.
- C. Duct test holes.
- D. Fire dampers.
- E. Flexible duct connectors.
- F. Volume control dampers.
- G. Low leakage (Class 1A) control dampers.

1.02 RELATED REQUIREMENTS

- A. Section 23 05 48 - Vibration and Seismic Controls for HVAC.
- B. Section 23 31 00 - HVAC Ducts and Casings.
- C. Section 23 36 00 - Air Terminal Units: Pressure regulating damper assemblies.

1.03 REFERENCE STANDARDS

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2024.
- B. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2020.
- C. UL 33 - Safety Heat Responsive Links for Fire-Protection Service Current Edition, Including All Revisions.
- D. UL 555 - Standard for Fire Dampers Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide for shop fabricated assemblies including volume control dampers. Include electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers.
- D. Project Record Drawings: Record actual locations of access doors and test holes.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

PART 2 - PRODUCTS

2.01 AIR TURNING DEVICES/EXTRACTORS

- A. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

2.02 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Access doors with sheet metal screw fasteners are not acceptable.

2.03 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.04 FIRE DAMPERS

- A. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.
- B. Horizontal Dampers: Galvanized steel, 22 gauge, 0.0299 inch frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.
- C. Fusible Links: UL 33, separate at 160 degrees F with adjustable link straps for combination fire/balancing dampers.

2.05 FLEXIBLE DUCT CONNECTORS

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Flexible Duct Connections: Fabric crimped into metal edging strip.
 - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
 - a. Net Fabric Width: Approximately 2 inches wide.
 - 2. Metal: 3 inches wide, 24 gauge, 0.0239 inch thick galvanized steel.
- C. Maximum Installed Length: 14 inch.

2.06 VOLUME CONTROL DAMPERS

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Single Blade Dampers:
 - 1. Fabricate for duct sizes up to 6 by 30 inch.
 - 2. Blade: 24 gauge, 0.0239 inch, minimum.
- C. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 by 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
 - 1. Blade: 18 gauge, 0.0478 inch, minimum.

2.07 LOW LEAKAGE (CLASS 1A) CONTROL DAMPERS

- A. Maximum Leakage Allowed: 3 cfm/sf at 1 inch wg.
 - B. Frame:
 - 1. Material: 12 gauge galvanized steel.
 - 2. Free-area: Single cross section.
 - 3. Blanked-off: Split frame into two free-area sections to allow a smaller free-area to be used for a minimum airflow intake or exhaust application and secondary free-area fully blanked-off.
 - C. Blade:
 - 1. Type: Single-blade rectangle shape.
 - 2. Operation: Opposed type.
 - 3. Maximum Individual Blade Height: 8 inches.
 - 4. Material: 12 gauge galvanized steel.
 - 5. Authority: Opposed type, 5 to 50 percent (typically 10 percent).
 - D. Insulation: Water-resistant sound absorbing material.
 - E. Temperature Service Range: Minus 25 to 185 degrees F (minus 32 to 85 degrees C).
-

PART 3 - EXECUTION**3.01 PREPARATION**

- A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 23 31 00 for duct construction and pressure class.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Provide duct test holes where indicated and required for testing and balancing purposes.
- D. Provide fire dampers and combination fire and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- E. Demonstrate re-setting of fire dampers to Owner's representative.
- F. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- G. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
- H. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

**SECTION 23 34 13
AXIAL HVAC FANS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Mixed flow fans.

1.02 RELATED REQUIREMENTS

- A. Section 23 05 48 - Vibration and Seismic Controls for HVAC.
- B. Section 23 33 00 - Air Duct Accessories: Backdraft dampers - metal.
- C. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.
- B. AMCA 99 - Standards Handbook; 2016.
- C. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2020.
- D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016, with Errata (2018).
- E. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; 2014.
- F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.

1.04 SUBMITTALS

- A. Product Data: Provide data on axial fans and accessories, including fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.
- B. Shop Drawings: Indicate assembly of axial fans and accessories including fan curves with specified operating point plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.
- C. Test Reports: Indicate performance data for adjustable axial fan blades for at least five-blade settings, including maximum.
- D. Manufacturer's Instructions: Indicate installation instructions.
- E. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors, shafts, and bearings from weather and construction dust.

1.07 FIELD CONDITIONS

- A. Do not use permanent fans for ventilation during construction.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Greenheck Fan Corporation: <https://www.greenheck.com/>

- B. Twin City Fan & Blower: www.tcf.com/#sle.
- C. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.02 MIXED FLOW FANS

- A. Performance Requirements:
 - 1. Performance Ratings: AMCA 210 or AMCA 204 certified, bearing respective rating seal.
 - 2. Sound Ratings: AMCA 301, tested to AMCA 300, bearing respective sound ratings seal.
 - 3. Fabrication: Comply with AMCA 99.
 - 4. Performance Base: Sea level conditions.
 - 5. Temperature Limit: Maximum 300 degrees F (149 degrees C).
- B. Fan Housing and Outlet
 - 1. Fan housing to be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence.
 - 2. Tubular fan housing shall be completely welded and coated with a minimum of 2-4 mils of Permator coating, electrostatically applied and baked. Finish color shall be RAL 7023, concrete grey. No uncoated metal fan parts will be allowed.
 - 3. Housing shall be constructed of welded structural steel members to prevent vibration and rigidly support the impeller and motor
 - 4. All mixed flow housings shall include vanes to straighten airflow prior to exiting the fan discharge.
 - 5. Units shall accommodate ceiling hung mounting without structural modifications to the fan.
 - 6. An access door shall be supplied for impeller inspection and service.
 - 7. Extended grease lubrication lines shall be provided from the motor bearings to the exterior of the fan housing
- C. Fan Impeller
 - 1. Fan impeller shall be mixed flow design. The impeller shall be electronically balanced both statically and dynamically to balance grade G6.3 per ANSI S2.19.
 - 2. Fan impeller shall be manufactured with continuously welded steel airfoils and coated with a minimum of 2-4 mils of Permator coating, electrostatically applied and baked. Finish color shall be RAL 7023, concrete grey.
 - 3. The wheel and fan inlet shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency
- D. Fan Motors and Drive
 - 1. Motors shall meet or exceed EPACT (Energy Policy ACT) efficiencies. Motors to be NEMA T-frame, 870, 1170 or 1770 in 60 Hz (950, 1440 in 50 Hz), Totally Enclosed Fan Cooled (TEFC) with a 1.15 service factor on line (sinewave) frequency.
 - 2. Motor shall be labeled for use with a VFD with 10:1 VT and 1.0 service factor.
 - 3. Internal shaft grounding ring shall be provided to protect the motor bearings from electrical damage.
- E. Performance Ratings: As indicated on drawings.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install with resilient mountings and flexible electrical leads; see Sections 23 05 48 and 26 05 83.
- C. Install flexible connections between axial fan inlet and discharge ductwork; see Section 23 33 00. Ensure metal bands of connectors are parallel with a minimum one inch (25 mm) flex between ductwork and axial fan while running.

END OF SECTION

SECTION 23 34 16 CENTRIFUGAL HVAC FANS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Backward inclined centrifugal fans.
- B. Bearings and drives.

1.02 RELATED REQUIREMENTS

- A. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
- B. Section 23 05 48 - Vibration and Seismic Controls for HVAC.
- C. Section 23 07 13 - Duct Insulation.
- D. Section 23 33 00 - Air Duct Accessories: Backdraft dampers.

1.03 REFERENCE STANDARDS

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings 2015 (Reaffirmed 2020).
- B. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program 2015.
- C. AMCA 99 - Standards Handbook 2016.
- D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating 2016, with Errata (2018).
- E. AMCA 300 - Reverberant Room Method for Sound Testing of Fans 2014.
- F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data 2022.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide data on centrifugal fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate assembly of centrifugal fans and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.
- D. Manufacturer's Instructions: Include complete installation instructions.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors, shafts, and bearings from weather and construction dust.

1.07 FIELD CONDITIONS

- A. Permanent fans may not be used for ventilation during construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS BY FAN TYPE

- A. Backward-Inclined Centrifugal Fans:
 - 1. Greenheck Fan Corporation: <https://www.greenheck.com/>

2. Twin City Fan & Blower: www.tcf.com/#sle.
3. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.02 PERFORMANCE REQUIREMENTS

- A. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
- C. Fabrication: Comply with AMCA 99.
- D. Performance Base: Sea level conditions.
- E. Temperature Limit: Maximum 300 degrees F.
- F. Static and Dynamic Balance: Eliminate vibration or noise transmission to occupied areas.

2.03 WHEEL AND INLET

- A. Backward Inclined: Steel or aluminum construction with smooth curved inlet flange, heavy back plate, backwardly curved blades welded or riveted to flange and back plate; cast iron or cast steel hub riveted to back plate and keyed to shaft with set screws.

2.04 HOUSING

- A. Heavy gauge steel, spot welded, adequately braced, designed to minimize turbulence with spun inlet bell and shaped cut.
- B. Factory finish before assembly to manufacturer's standard. For fans handling air downstream of humidifiers, fabricate of galvanized steel.

2.05 BEARINGS AND DRIVES

- A. Bearings: Heavy duty pillow block type, selfgreasing ball bearings, with ABMA STD 9 life at 50,000 hours.
- B. Shafts: Hot rolled steel, ground and polished, with keyway, protectively coated with lubricating oil, and shaft guard.
- C. Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 15 hp and under, selected so required rpm is obtained with sheaves set at mid Fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install flexible connections between fan inlet and discharge ductwork; refer to Section 23 33 00. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

END OF SECTION

**SECTION 23 36 00
AIR TERMINAL UNITS**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Single-duct terminal units.
 - 1. Single-duct, variable-volume units.

1.02 RELATED REQUIREMENTS

- A. Section 23 09 13 - Instrumentation and Control Devices for HVAC: Thermostats and actuators.
- B. Section 23 09 23 - Direct-Digital Control System for HVAC.
- C. Section 23 21 13 - Hydronic Piping: Connections to heating coils.
- D. Section 23 21 14 - Hydronic Specialties: Connections to heating coils.
- E. Section 23 31 00 - HVAC Ducts and Casings.
- F. Section 23 33 00 - Air Duct Accessories.
- G. Section 23 37 00 - Air Outlets and Inlets.

1.03 REFERENCE STANDARDS

- A. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils 2001, with Addenda (2011).
- B. AHRI 880 (I-P) - Performance Rating of Air Terminals 2017 (Reaffirmed 2023).
- C. ASHRAE Std 130 - Laboratory Methods of Testing Air Terminal Units 2016.
- D. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material) 2019.
- E. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements 2022.
- F. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2024.
- G. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate air flow, static pressure, and NC designation. Include electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.
 - 1. Include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures of 1 to 4 inch wg.
- D. Manufacturer's Installation Instructions: Indicate support and hanging details, installation instructions, recommendations, and service clearances required.
- E. Project Record Documents: Record actual locations of units and controls components and locations of access doors required for access of valving.
- F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.
- G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 WARRANTY

- A. Provide 18-month manufacturer warranty for air terminal units and integral heating coils.

PART 2 - PRODUCTS**2.01 SINGLE-DUCT, VARIABLE-VOLUME UNITS**

- A. Manufacturers:
1. Johnson Controls, Inc: www.johnsoncontrols.com
 2. Price Industries, Inc: www.priceindustries.com
 3. Titus: <https://www.titus-hvac.com>
 4. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. General:
1. Factory-assembled, AHRI 880 (I-P) rated and bearing the AHRI seal, air volume control terminal with damper assembly, flow sensor, externally mounted volume controller, duct collars, and all required features.
 2. NEMA-1 control box with access panel bearing identification, including but not necessarily limited to nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil (right or left hand) connection, where applicable.
- C. Unit Casing:
1. Minimum 22 gauge, 0.0299 inch galvanized steel.
 - a. Assembled with longitudinal lock seam construction.
 - b. Casing leakage to meet ASHRAE Std 130.
 2. Air Inlet Collar: Provide round or rectangular, suitable for standard flexible duct sizes.
 3. Unit Discharge: Rectangular, with slip-and-drive connections.
 4. Bottom Access Door: Casing shall have removable panels large enough to provide access for inspection, adjustment and maintenance without disconnecting ducts. Panels shall be flush, gasketed airtight, and held in place by screwdriver operated fasteners.
 5. Acceptable Liners:
 - a. 1 inch thick, coated, fibrous-glass complying with ASTM C1071.
 - 1) Secure with adhesive.
 - 2) Coat edges exposed to airstream with NFPA 90A approved sealant.
 - 3) Cover liner with high density mat facing.
 - b. Liner not to contain pentabrominated diphenyl ether (CAS #32534-81-9) or octabrominated diphenyl ether.
- D. Damper Assembly:
1. Heavy-gauge, galvanized steel or extruded aluminum construction with solid steel, nickel-plated shaft pivoting on HDPE, self-lubricating bearings.
 2. Provide integral position indicator or alternative method for indicating damper position over full range of 90 degrees.
 3. Incorporate low leak damper blades for tight airflow shutoff.
 - a. Air Leakage Past Closed Damper: Maximum two percent of unit maximum airflow at 3 inch wg inlet static pressure, tested in accordance with ASHRAE Std 130.
- E. Hot Water Heating Coil:
1. Coil Casing: Minimum 22 gauge, 0.0299 inch galvanized steel, factory-installed on terminal discharge with rectangular outlet, duct connection type.
 - a. Access Door: Gasketed and insulated located on bottom.
 - b. Right or left coil inlets.
 2. Coil Fins: Aluminum or aluminum plated 0.0045 inch fins, mechanically-bonded to seamless 0.50 by 0.016 inch copper tubes.
 - a. Fins to be formed in a high heat transfer sine wave configuration.
 - b. 1-2 rows with ten fins-per-inch heating capacity density.
-

-
3. Coil leak tested to minimum 350 psig.
 - a. Minimum Burst Pressure: 1800 psi.
 4. Base performance data on tests run in accordance with AHRI 410 and units to bear AHRI 410 label.
- F. Controls:
1. DDC (Direct-Digital Controls):
 - a. Bi-directional Damper Actuator: 24 volt, powered closed, spring return open.
 - b. Microprocessor-Based Controller: Air volume controller, pressure-independent with electronic airflow transducers, factory-calibrated maximum and minimum CFM's.
 - 1) Occupied and unoccupied operating mode.
 - 2) Remote reset of temperature or CFM set points.
 - 3) Proportional, plus integral control of room temperature.
 - 4) Monitoring and adjusting with portable terminal.
 - 5) Time-proportional reheat coil control.
 - c. Room Sensor:
 - 1) Compatible with temperature controls specified.
 - 2) Wall-mounted, system powered, with temperature set-point adjustment including connection access for portable operator terminal.
 - d. See Section 23 09 13 for room sensor requirements.
 - e. See Section 23 09 23 for DDC controller requirements.
 2. Airflow Sensor: Differential pressure airflow device measuring total, static, and wake pressures.
 - a. Plastic parts are fire-resistant, complying with UL 94.
 - b. Provides accuracy within 5 percent with a 90 degree sheet metal elbow directly at the inlet of the assembly.
 - c. Control tubing is protected by grommets at the wall of the air flow sensor's housing.
 - d. Furnished with twelve total pressure sensing ports and a center averaging chamber that amplifies the sensed air flow signal.
 - e. Signal accuracy: Plus/minus five percent throughout terminal operating range.
 3. Control Sequence:
 - a. Suitable for operation with duct pressures between 0.25 and 3.0 inch wg inlet static pressure.
 - b. Include factory-mounted and piped, 5-micron filter; and adjustable, velocity-resetting, high-limit control with amplifying relay.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that conditions are suitable for installation.
- B. Verify that field measurements are as indicated on drawings.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
 - B. Install the inlets of air terminal units and air flow sensors a minimum of four duct diameters from elbows, transitions, and duct takeoffs.
 - C. See drawings for the size(s) and duct location(s) of the air terminal units.
 - D. Provide ceiling access doors or locate units above easily removable ceiling components.
 - E. Support units individually from structure.
 - F. Embed anchors in concrete in accordance with ASTM E488/E488M.
 - G. Do not support from ductwork.
 - H. Connect to ductwork in accordance with Section 23 31 00.
-

- I. Provide minimum of 5 ft of 1 inch thick lined ductwork downstream of units.

3.03 ADJUSTING

- A. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to zero percent full flow.

END OF SECTION

**SECTION 23 37 00
AIR OUTLETS AND INLETS**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Diffusers:
 - 1. Rectangular ceiling diffusers.
 - 2. Slot ceiling diffusers.
- B. Registers/grilles:
 - 1. Ceiling-mounted, egg crate exhaust and return register/grilles.
 - 2. Ceiling-mounted, exhaust and return register/grilles.
 - 3. Wall-mounted, supply register/grilles.
 - 4. Wall-mounted, exhaust and return register/grilles.
- C. Louvers.

1.02 REFERENCE STANDARDS

- A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating 2023.
- B. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices 2021, with Editorial Revision (2022).
- C. AMCA 550 - Test Method for High Velocity Wind Driven Rain Resistant Louvers 2022.
- D. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Air Inlets 2023.

1.03 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required 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.

1.04 QUALITY ASSURANCE

- A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.
- B. Test and rate louver performance in accordance with AMCA 500-L.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Price Industries: www.price-hvac.com/#sle.
- B. Titus, a brand of Air Distribution Technologies: www.titus-hvac.com/#sle.
- C. Tuttle and Bailey: www.tuttleandbailey.com/#sle.
- D. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.02 RECTANGULAR CEILING DIFFUSERS

- A. Type: Provide square plaque style diffuser to discharge air in four way pattern.
- B. Connections: Round.
- C. Frame: Provide inverted T-bar type. In plaster ceilings, provide plaster frame and ceiling frame.
- D. Fabrication: Steel with baked enamel finish.
- E. Color: As indicated on drawings.

2.03 CEILING SLOT DIFFUSERS

- A. Type: Continuous vanes for left, right, or vertical discharge.
 - B. Fabrication: Aluminum extrusions with factory clear lacquer finish.
-

- C. Color: To be selected by Architect from manufacturer's standard range.
- D. Frame: As indicated on drawings.
- E. Plenum: Integral, galvanized steel, insulated.

2.04 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with blades set at 45 degrees, horizontal face.
- B. Frame: 1-1/4 inch margin with countersunk screw mounting.
- C. Fabrication: Steel with 20 gauge, 0.0359 inch minimum frames and 22 gauge, 0.0299 inch minimum blades, steel and aluminum with 20 gauge, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked enamel finish.
- D. Color: As indicated on the drawings.

2.05 CEILING EGG CRATE EXHAUST AND RETURN GRILLES

- A. Type: Egg crate style face consisting of 1/2 by 1/2 by 1/2 inch and 1/2 by 1/2 by 1 inch grid core.
- B. Fabrication: Grid core consists of aluminum with baked enamel finish.
- C. Color: As indicated on the drawings.
- D. Frame: Channel lay-in frame for suspended grid ceilings.

2.06 WALL SUPPLY REGISTERS/GRILLES

- A. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, horizontal face, double deflection.
- B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.
- C. Fabrication: Steel with 20 gauge, 0.0359 inch minimum frames and 22 gauge, 0.0299 inch minimum blades, steel and aluminum with 20 gauge, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked enamel finish.
- D. Color: As indicated on the drawings.

2.07 WALL EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with spring or other device to set blades, horizontal face.
- B. Frame: 1-1/4 inch margin with countersunk screw mounting.
- C. Fabrication: Steel frames and blades, with factory baked enamel finish.
- D. Color: As indicated on the drawings.

2.08 LOUVERS

- A. Manufacturers:
 - 1. Greenheck
 - 2. Pottorff
 - 3. Ruskin Company
 - 4. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
- B. Fabrication: 12 gauge, 0.1046 inch (2.66 mm) thick extruded aluminum welded assembly, with factory fluoropolymer spray finish.
- C. Refer to drawings for sizing and performance.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

- B. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.
- C. Install diffusers to ductwork with air tight connection.
- D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.
- E. Paint ductwork visible behind air outlets and inlets matte black.

END OF SECTION

SECTION 23 64 33 MODULAR WATER CHILLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Packaged water-cooled water chiller.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete housekeeping pads.
- B. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
- C. Section 23 05 48 - Vibration and Seismic Controls for HVAC.
- D. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.
- E. Section 23 21 13 - Hydronic Piping.
- F. Section 23 21 14 - Hydronic Specialties.
- G. Section 25 35 19 - Integrated Automation Control Valves.
- H. Section 26 05 83 - Wiring Connections.

1.03 REFERENCE STANDARDS

- A. AHRI 550/590 (I-P) - Performance Rating of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle 2023.
- B. AHRI 575 - Method of Measuring Machinery Sound Within an Equipment Space 2017.
- C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems 2022, with Errata (2023).
- D. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks 2020, with Errata (2023).
- F. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels 2023.
- G. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus 2019.
- H. UL 1995 - Heating and Cooling Equipment Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
 - B. Product Data: Provide rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.
 - C. Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.
 - D. Manufacturer's Certificate: Certify that components furnished but not produced by manufacturer meet or exceed manufacturer's requirements.
 - E. Manufacturer's Performance Data: Indicate energy input versus cooling load output from 0 to 100 percent of full load at specified and minimum condenser water temperature for water-cooled chillers and at specified and minimum outdoor air temperature for air-cooled chillers.
 - F. Manufacturer's Instructions: Submit manufacturer's complete installation instructions.
 - G. Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories; include trouble-shooting guide.
-

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Multistack LLC
- B. WaterFurnace International, Inc
- C. ClimaCool Corp.
- D. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.02 WATER-COOLED MODULAR WATER CHILLER CONSTRUCTION REQUIREMENTS

- A. Factory assembled and tested package-module consisting of compressor(s), compressor motor(s), evaporator, condenser, enclosure, refrigeration circuits(s) and specialties, interconnecting piping, water circuit isolation valves, starters, and microprocessor-based controls.
 - 1. Rating: AHRI 550/590 (I-P).
 - 2. Safety: UL 1995 and ASHRAE Std 15.
 - 3. Machinery Sound Testing: AHRI 575.
 - 4. Construction & Testing: ASME BPVC-VIII-1 if applicable for construction type.
 - 5. Energy Efficiency: ASHRAE Std 90.1.
 - 6. Enclosures:
 - a. Frame: Heavy gauge steel with factory painted finish.
 - b. Cabinet: Factory baked on enamel finish.
 - c. Perform 500-hour minimum salt spray test in accordance with ASTM B117 for units exposed to outdoor conditions.
- B. Hermetic Scroll Compressors:
 - 1. Module: Fully hermetic with two, direct drive variable speed compressors, adequate valve types and specialties required for operation and servicing in accordance with manufacturer's recommendations.
 - 2. Vibration Control: Factory installed internal rubber-in-shear isolators.
 - 3. Lubrication System: Initial oil charge, oil pump, oil level sight glass, and oil charging valve.
 - 4. Capacity Reduction System: Compressor staging with duty cycling based on run time.
 - 5. Motors: UL 984, 3,600, suction gas-cooled, with overload protection; see Section 23 05 13.
- C. Evaporator Side:
 - 1. Brazed plate made of 316 stainless steel.
 - 2. Working Pressure Rating, Refrigerant Side: 650 psi minimum.
 - 3. Working Pressure Rating, Water Side: 285 psi minimum.
 - 4. End Connections: Provide with flanged end connections.
- D. Cold Surface Insulation:
 - 1. Insulation is factory or field installed on evaporator, connections, and suction piping.
 - 2. inches minimum thick, closed cell, expanded polyvinyl chloride, polyurethane, or Armaflex II insulation with a maximum K factor of 0.28.
- E. Provide factory installed vents and water drain connections on evaporator or piping.
- F. Freeze Protection for Outdoor Locations: Provide thermostatically controlled electric heater to protect from freezing at ambient temperatures down to minus 20 degrees F.
- G. Provide factory-installed manual isolation valves in supply and return piping with modulating valve for variable primary flow operation.
- H. Water-Cooled Condenser:
 - 1. Brazed plate made of 316 stainless steel.
 - 2. Working Pressure Rating, Water Side: 285 psi minimum.
 - 3. End Connections: Provide with flanged connections.
 - 4. Provide factory or field installed vents and water drain connections on condenser or piping.

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5. Provide factory or field installed fittings for temperature control sensors on condenser or piping.
 - I. Refrigeration Circuits:
 1. Provide two independent refrigeration circuits with one compressor per circuit.
 2. Provide liquid line shut-off valve, filter-drier, thermal expansion valve, refrigerant relief device, and compressor discharge check valve for each independent circuit.
 - J. Controls Package:
 1. Unit Controls: Factory-supplied DDC:
 - a. Control-panel mounted with required input-output expansions, power supply, fused disconnect, hand switches, knobs, and accessories required to control chiller unit to manufacturer required sequences to meet intended use with listed performance.
 - b. Factory configured to interface prewired sensors, switches, and safeties with allowance to add up to four chiller valves and flow sensors.
 - c. Graphic-based touchscreen to include unit operation controls and user filter based interface for faults, alarms, performance, unit diagnostics, and data recording up to 12 months.
 - d. BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135 BACnet MS/TP.
 - e. External Point Mapping: Provide mapping table for each parameter included in the local visual interface with software-toggle flag to allow reduced mapping of available points.
 - f. Isolation Valves: Field-installed, 2-position, butterfly type with position tracking; see Section 25 35 19.
 2. Prewire, assemble, factory mount, and test operating and safety control system consisting of a digital display or gauges, on-auto-off switch, motor starting contactors, disconnect switches, power and control wiring. Provide controls, monitoring, programmable setpoints, alarms, and BAS as defined below:
 - a. Automatic Adjustable Operating Controls:
 - 1) Temperature of chilled water leaving chiller.
 - 2) Number of compressor circuits required to operate based on setpoints and system load.
 - 3) Compressor short-cycling prevention.
 - 4) Lead/lag operation for compressors. New lead compressor selected every 24 hours to equalize run time.
 - 5) Automatic reset on power source failure.
 - 6) Load limiting.
 - b. Normal Operation Monitoring and Open Coverless Displays:
 - 1) Hours of operation.
 - 2) Suction and discharge refrigerant pressures.
 - 3) Automatic diagnostics.
 - 4) Number of starts.
 - 5) On/off compressor status.
 - 6) Entering and leaving chilled water temperatures.
 - 7) Status of operation.
 - 8) Compressor winding temperature.
 - 9) Suction temperature.
 - 10) Oil pressure.
 - c. Setpoints:
 - 1) Leaving chilled water temperature.
 - 2) Date/time.
 - d. Automatic Chiller Shut-Down Safety Controls and Alarm:
 - 1) Automatic Reset:
 - (a) Chilled water flow interlock.
 - (b) Voltage protection (over/under).
 - (c) Phase reversal protection.

- 2) Manual Reset:
 - (a) Low suction pressure.
 - (b) High motor winding temperature.
 - (c) Low chilled water temperature.
 - (d) Low chilled water flow.
 - (e) High condenser refrigerant discharge pressure.
 - (f) Motor current overload and phase loss.
 - (g) Low oil flow.
- 3) Remote Alarm: Activate remote, audible bell upon safety shutdown of chiller.
- 4) Minimum Data Transmission to BAS:
 - (a) All system operating conditions.
 - (b) Capacity control information.
 - (c) Safety shutdown conditions.
- 5) Minimum Operating Commands from BAS:
 - (a) Remote unit start/stop.
 - (b) Remote chilled water reset.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Align chiller package on steel or concrete foundations.
- C. Install units on vibration isolators, see Section 23 05 48.
- D. Connect to electrical service.
- E. Connect to chilled water piping.
- F. Connect to hot water piping.
- G. Connect to condenser water piping.
- H. Arrange piping for easy dismantling to permit tube cleaning and removal.

3.02 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate operation of system to Owner's personnel.
 1. Use operation and maintenance data as reference during demonstration.
 2. Briefly describe function, operation, and maintenance of each component.
- B. Training: Train Owner's personnel on operation and maintenance of system.
 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 2. Provide minimum of two hours of training.

END OF SECTION

SECTION 23 72 23
PACKAGED AIR-TO-AIR ENERGY RECOVERY UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Energy recovery units.
- B. Casing.
- C. Fans.
- D. Energy Recovery Device.
- E. Filters.
- F. Power and controls.
- G. Accessories.

1.02 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Manufacturer's installation instruction, product data, and engineering calculations.
- C. Shop Drawings: Show design and assembly of energy recovery unit and installation and connection details.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Firm regularly engaged in manufacturing energy recovery units.
 - 2. Products in satisfactory use in similar service for not less than five years.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store in manufacturer's unopened packaging.
- B. Store products to be installed indoors in dry, heated area.

1.05 WARRANTY

- A. See Section 01 77 00 - Closeout Submittals for City of Madison additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Energy Recovery Ventilators:
 - 1. Oxygen 8 Nova; <https://oxygen8.ca/nova-erv/>.
 - 2. Renew Aire; <https://renewaire.com/>
 - 3. Greenheck Fan Corporation; <https://www.greenheck.com/>
 - 4. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.02 ENERGY RECOVERY UNITS

- A. Energy Recovery Units: Provide stationary core air-to-air exchanger; prefabricated packaged system designed by manufacturer.
 - 1. Provide unit with a AHRI 1060 (I-P) compliant air-to-air exchanger.
 - 2. Access: Hinged and/or screwed access panels on front.
 - 3. Lifting holes at the unit base.
 - 4. Framing: Welded extruded aluminum tubular frame capable of supporting components and casings.
 - 5. Permanent name plate listing manufacturer mounted inside door near electrical panel.

2.03 CASING

- A. Cabinet shall be nominal 1 inch double wall panel with R6.5 2.5lb/ft³ polyurethane foam thermal insulation. Cabinet exterior shall be 20-gauge pre-painted steel that meets or exceeds 650-hour salt spray test based on ASTM B117. 22 Gauge liners and other steel components shall be galvanized steel. All seams shall be sealed to provide airtight casing.
- B. Doors shall be nominal 1 inch double wall panel with the same construction as cabinet. Doors shall be fitted with hinges and door handles. The doors shall have one lockable handle as standard.
- C. The unit will be designed for service and maintenance on one side only to allow for a compact installation.

2.04 FANS

- A. Fans shall be mixed flow plenum type with direct drive motor. Fan and motor assembly shall be factory mounted and balanced. The fans will be capable of operating in ambient temperatures of up to 40°C.
- B. Fan motors shall be permanent magnet, synchronous motor type with integral digital motor controller. Fan bearings shall be serviceable type with an L-10 life of 40,000 hours. Fan motors will be UL approved.
- C. All fans shall be equipped with integral airflow monitoring system connected to the unit controller.
- D. Provide means to easily remove fan-motor assembly for service through standard doors.
- E. Fans should be designed such that all service can be performed in the field, including replacement of bearings.
- F. Fan motor drives shall be 208/60/3 and be UL approved. Fans will be protected by UL approved motor protection circuit breaker.

2.05 ENERGY RECOVERY DEVICE

- A. Where indicated, units shall include plate type cross flow heat exchanger fabricated from polymer membrane. Unit shall be capable of withstanding a maximum of 7.2" w.c. Maximum leakage between airstreams shall be 0.5% of nominal airflow.
- B. The energy recover efficiency must be a minimum of 50% Total to meet ASHRAE 90.1.
- C. The energy recovery device must have an ISO Hygiene rating of 0.
- D. Energy recovery device shall be AHRI 1060 certified
- E. Unit shall include a bypass damper with modulating actuator. Unit controller shall operate bypass dampers during economizer mode.

2.06 FILTERS

- A. Unit shall include 2" filter rack for the supply air and return air paths upstream of energy recovery exchanger. Filters shall be accessed through hinged filter access door. Supply one set of MERV 13 pleated filters for the Outdoor air stream and one set of MERV 8 for the Return air stream. All filters must be UL approved.
- B. Provide factory mounted pressure sensors to measure filter pressure drop across pre-filter and main filter. Pressure drop shall be digitally feedback to controller for utilization in control and alarm sequencing. Unit controller shall monitor filter pressure level and report when filter changes are required.

2.07 POWER AND CONTROLS

- A. Motor Control Panels: UL listed.
 - B. Include necessary motor starters, fuses, transformers and overload protection according to NFPA 70.
 - C. Provide single-point field connection to power supply.
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- D. Provide non fused main disconnect integral to control panel.
- E. Install wiring in accordance with NFPA 70.
- F. Wiring: Enclosed in flexible, liquid tight steel conduit.
- G. Unit shall include an integrated microprocessor-based unit controller. The controls shall be located in the integral control's cabinet. All unit controls shall operate off a transformer from the main power supply for single point power connection. All internal controls and sensors shall be factory prewired and tested.
- H. The control system will regulate temperatures, airflows and other functions as required. Unit controller shall be pre-programmed with factory tested software for all possible functions.
- I. The controller shall provide the following, refer to sequence of operation for specific unit control sequences;
 - 1. Control of fans correcting for both changes in total static pressure and air density in both VAV and constant airflow applications.
 - 2. Fan performance monitoring.
 - 3. Ventilation airflow monitoring and control.
 - 4. Airflow density correction for winter and summer conditions. Energy recovery optimization including operation of bypass damper. Supplemental heating and cooling when included. Frost protection. Monitoring alarms, faults and maintenance points including filter changeout. Time and date schedules. Humidity control. Data logging and trending.
 - 5. Energy recovery optimization including operation of bypass damper.
 - 6. Supplemental heating and cooling when included.
 - 7. Frost protection.
 - 8. Monitoring alarms, faults and maintenance points including filter changeout. Time and date schedules. Humidity control. Data logging and trending.
 - 9. Time and date schedules.
 - 10. Humidity control.
 - 11. Data logging and trending.
- J. If non factory controls are proposed as an option, a factory witness test is required to show integration and functionality.
- K. Controller shall be BACnet IP and BTL certified and include Modbus communication. Communication shall include monitoring, control, alarms, faults and maintenance information.
- L. Provide factory installed and tested contactors, overloads, fusing, starters motor speed controllers for supply and exhaust. Include all necessary control transformers.
- M. Provide unit mounted non-fused disconnect switch with single point power connection.
- N. Supply all necessary temperature and pressure sensors complete with plug in wiring harnesses for proper option of unit.

2.08 ACCESSORIES

- A. Electric Preheat Coil (Installed Remotley):
 - 1. Provide open coil electric heaters of the size, capacity and performance shown in the equipment schedules.
 - 2. All duct heaters shall be tested and certified to UL and CSA.
 - 3. Frame to be corrosion-resistant and made of galvanized steel.
 - 4. Coils shall be made of high-grade Nickel-Chrome alloy and shall be insulated from the frame by means of non-rotating ceramic bushings.
 - 5. Heater to come with door mounted disconnect switch and air proving switch
 - 6. SCR control is time proportioning type that modulates the heater and supplies the exact amount of power to match the demand. Input signal will be 0-10V.

7. Duct heaters shall be non-sensitive to air flow direction and interchangeable for horizontal or vertical ducts without impairing safety.
- B. Chilled Water Cooling Coil (Installed Remotely):
 1. Where indicated, unit shall include AHRI 410 certified fin tube type chilled water coil.
 2. Fins shall be aluminum with a minimum thickness of 0.006".
 3. Tubes shall be 5/8" OD, minimum 0.020" tube wall seamless copper tube mechanically expanded into fins.
 4. Coil casings shall be galvanized steel.
 5. Coils shall include external drain and vent connections.
 6. Coil shall be mounted in a rack over a stainless-steel double sloped condensate pan.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation shall be accomplished in accordance with project drawings, manufacturer's installation instructions as documented in manufacturer's IOM, best practices, and all applicable building codes.

3.02 CLEANING

- A. Clean filters, air plenums, interior and exposed-to-view surfaces prior to Substantial Completion.

END OF SECTION

SECTION 23 73 13
MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Casing construction.
- B. Fan section.
- C. Coil section.
- D. Filter and air cleaner section.
- E. Damper section.
- F. Access section.
- G. Turning and discharge plenum section.
- H. Controls.

1.02 RELATED REQUIREMENTS

- A. Applicable provisions of Division 01 – General Requirements shall govern all work under this Section.
- B. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
- C. Section 23 05 48 - Vibration and Seismic Controls for HVAC.
- D. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.
- E. Section 23 07 19 - HVAC Piping Insulation.

1.03 REFERENCE STANDARDS

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015 (Reaffirmed 2020).
- B. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addenda (2011).
- C. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.
- D. AMCA 99 - Standards Handbook; 2016.
- E. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016, with Errata (2018).
- F. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; 2014.
- G. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.
- H. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2018.
- I. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks; 2020, with Errata and Amendments (2021).
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- M. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- N. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data:
 - 1. Published Literature: Indicate dimensions, weights, capacities, ratings, gauges and finishes of materials, and electrical characteristics and connection requirements.
 - 2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
 - 3. Fans: Performance and fan curves with specified operating point clearly plotted, power, RPM.
 - 4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity.
 - 5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
- C. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- D. Manufacturer's Instructions: Include installation instructions.
- E. Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Fan Belts: One set for each unit.
 - 2. Extra Filters: One set for each unit.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.
- B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.
- C. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.06 WARRANTY

- A. Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Daikin Applied: www.daikinapplied.com/#sle.
- B. Trane Inc: www.trane.com/#sle.
- C. York International Corporation / Johnson Controls Inc: www.york.com/#sle.
- D. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.02 REGULATORY REQUIREMENTS

- A. Comply with NFPA 70.
- B. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

2.03 CASING CONSTRUCTION

- A. Full Perimeter Base Rail:
 - 1. Construct of galvanized steel.
 - 2. Provide base rail of sufficient height to raise unit for external trapping of condensate drain pans.
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- B. Casing:
 - 1. Construct of one piece, insulated, double wall panels.
 - 2. Provide mid-span, no through metal, internal thermal break.
 - 3. Construct outer panels of galvanized steel and inner panels of galvanized steel.
 - 4. Casing Air Pressure Performance Requirements:
 - a. Able to withstand up to 8 in-wc positive or negative static pressure.
 - b. Not to exceed 0.0042 inches per inch deflection at 1.5 times design static pressure up to a maximum of plus 8 in-wc in positive pressure sections and minus 8 in-wc in negative pressure sections.
 - C. Access Doors:
 - 1. Construction, thermal and air pressure performance same as casing.
 - 2. Provide surface mounted handles on hinged, swing doors.
 - 3. Door swing shall open in direction against pressure of unit.
 - 4. Provide shatterproof viewing window designed to withstand operating pressures.
 - D. Unit Flooring: Construct with sufficient strength to support expected people and equipment loads associated with maintenance activities.
 - E. Casing Leakage: Seal joints and provide airtight access doors so that air leakage does not exceed one percent of design flow at the specified casing pressure.
 - F. Insulation:
 - 1. Provide foam injected panels having a minimum thermal resistance of R-13 throughout.
 - 2. Completely fill panel cavities in each direction to prevent voids and settling.
 - 3. Comply with NFPA 90A.
 - G. Drain Pan Construction:
 - 1. Provide cooling coil and humidifier sections with an insulated, double wall, Type 304 stainless steel drain pan complying with ASHRAE Std 62.1 for indoor air quality and sufficiently sized to collect all condensate.
 - 2. Slope in two planes to promote positive drainage and eliminate stagnate water conditions. Pipe upper drain pans individually down to bottom drain pan using a minimum 1 inch pipe constructed of drain pan material.
 - 3. Locate outlet of sufficient diameter at lowest point of pan to prevent overflow at normal operating conditions.
 - 4. Provide threaded drain connections constructed of drain pan material, extended sufficient distance beyond the base to accommodate field installed, condensate drain trapping.
 - H. Marine Lights:
 - 1. Provide factory-mounted, water- and dust-resistant LED fixture(s) in all fan sections and access sections, with the following characteristics:
 - a. Non-ferrous metal housing.
 - b. Glass or polycarbonate lens.
 - c. Factory wired to a single switch within factory provided service module.
 - d. Instant on white light with minimum 8,000 hour service life.
 - 2. Provide factory installed service module including GFCI receptacle independent from load side; designed to receive power from field supplied 120 volt source.
 - I. Finish:
 - 1. Indoor Units:
 - a. Provide exterior, galvanized steel panels without paint.
 - b. Color: Manufacturer's standard color.

2.04 FAN SECTION

- A. Type: Air foil, single width, single inlet, centrifugal plenum type fan, in compliance with AMCA 99.
-

- B. Performance Ratings: Determined in accordance with AMCA 210 and labeled with AMCA Certified Rating Seal.
- C. Sound Ratings: AMCA 301; tested to AMCA 300 and label with AMCA Certified Sound Rating Seal.
- D. Bearings: Self-aligning, grease lubricated, with lubrication fittings extended to exterior of casing with plastic tube and grease fitting rigidly attached to casing.
- E. Mounting:
 - 1. Locate fan and motor internally on welded steel base coated with corrosion resistant paint.
 - 2. Factory mount motor on slide rails.
 - 3. Provide access to motor, drive, and bearings through removable casing panels or hinged access doors.
 - 4. Provide built-in inertia base of welded steel with bottom sheet and reinforcing grid for concrete ballast.
- F. External Motor Junction Box: Factory mount NEMA 4 external junction box and connect to extended motor leads from internally mounted motors.
- G. Motor Wiring Conduit: Factory wire fan motor wiring to the unit mounted variable frequency drive.
- H. Drives:
 - 1. Comply with AMCA 99.
 - 2. Bearings: Heavy duty pillow block type, ball bearings, with ABMA STD 9 L-10 life at 50,000 hours.
 - 3. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.
 - 4. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts, and keyed. Variable and adjustable pitch sheaves for motors 15 hp and under selected so required rpm is obtained with sheaves set at mid-position; fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.
 - 5. Belt Guard: Fabricate to SMACNA (DCS); 0.106 inch thick, 3/4 inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

2.05 COIL SECTION

- A. Casing: Provide access to both sides of coils. Enclose coils with headers and return bends fully contained within casing. Slide coils into casing through removable end panel with blank off sheets and sealing collars at connection penetrations.
- B. Drain Pans: Install drain pan under each cooling coil bank extending entire width of coil, including header, and from upstream face of each coil to a distance 1/2 of vertical coil height of the bottom coil or 6 inches, whichever is greater, downstream from the downstream face.
- C. Air Coils:
 - 1. Certify capacities, pressure drops, and selection procedures in accordance with AHRI 410.
- D. Fabrication:
 - 1. Tubes: 5/8 inch OD seamless copper expanded into fins, brazed joints.
 - 2. Fins: Aluminum.
 - 3. Casing: Die formed channel frame of galvanized steel.
- E. Water Heating Coils:
 - 1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
 - 2. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.

F. Water Cooling Coils:

1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
2. Configuration: Drainable, with threaded plugs for drain and vent; threaded plugs in return bends and in headers opposite each tube.

2.06 FILTER AND AIR CLEANER SECTION

- A. General: Provide filter sections with filter racks, minimum of one access door for filter removal, and filter block-offs to prevent air bypass.
- B. Differential Pressure Gauge:
 1. Provide factory installed dial type differential pressure gauge, flush mounted with casing outer wall, and fully piped to both sides of each filter to indicate status.
 2. Maintain plus/minus 5 percent accuracy within operating limits of 20 degrees F to 120 degrees F.

2.07 DAMPER SECTION

- A. Mixing Section: Provide a functional section to support the damper assembly for modulating the volume of outdoor and return air.
- B. Damper Blades:
 1. Double-skin airfoil design with metal, compressible jamb seals and extruded-vinyl blade-edge seals on each blade.
 2. Self-lubricating stainless steel or synthetic sleeve bearings.
 3. Comply with ASHRAE Std 90.1 I-P for rated maximum leakage rate.
 4. Provide leakage testing and pressure ratings in compliance with AMCA 500-D test methods.
 5. Arrange in parallel or opposed-blade configuration.

2.08 ACCESS SECTION

- A. Provide where indicated on drawings to allow for inspection, cleaning, and maintenance of field-installed components.
- B. Construct access doors same as previously specified within this Section.

2.09 TURNING AND DISCHARGE PLENUM SECTION

- A. Provide plenum to efficiently turn and discharge air.
 1. Scale plenum vertical height to accommodate discharge duct height.
 2. Scale plenum horizontal length to accommodate required dimensional constraints.

2.10 CONTROLS

- A. Combination VFD - Disconnects:
 1. Provide factory mounted, combination VFD - disconnect for each fan motor.
 - a. Provide in accordance with Section 26 29 23.
 2. Mount VFD-disconnect on fan section externally in a NEMA 1 enclosure within a dedicated controls section or housed fan section.
- B. BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135 BACnet MS/TP.
- C. External Point Mapping: Provide mapping table for each parameter included in the local visual interface with software-toggle flag to allow reduced mapping of available points.

PART 3 EXECUTION**3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Bolt sections together with gaskets.
- C. Provide fixed sheaves required for final air balance.
- D. Make connections to coils with unions or flanges.

- E. Hydronic Coils:
 - 1. Hydronic Coils: Connect water supply to leaving air side of coil (counterflow arrangement).
 - 2. Provide shut-off valve on supply line and lockshield balancing valve with memory stop on return line.
 - 3. Locate water supply at bottom of supply header and return water connection at top.
 - 4. Provide manual air vents at high points complete with stop valve.
 - 5. Ensure water coils are drainable and provide drain connection at low points.
- F. Cooling Coils:
 - 1. Pipe drain and overflow to nearest floor drain.

3.02 SYSTEM STARTUP

- A. Prepare and start equipment and systems in accordance with manufacturers' instructions and recommendations.
- B. Adjust for proper operation within manufacturer's published tolerances.

3.03 CLOSEOUT ACTIVITIES

- A. See Section 01 77 00 - Closeout Submittals for City of Madison closeout submittals.
- B. See Section 01 79 00 - Demonstration and Training for City of Madison additional requirements.
- C. Demonstrate proper operation of equipment to Owner's designated representative.
- D. Training: Train Owner's personnel on operation and maintenance of system.
 - 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. Location: At project site.

END OF SECTION

SECTION 23 81 26.13
SMALL-CAPACITY SPLIT-SYSTEM AIR CONDITIONERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Air-source heat pumps.
- B. Indoor air handling (fan and coil) units for ductless systems.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment 2023.
- B. AHRI 270 - Sound Performance Rating of Outdoor Unitary Equipment 2015, with Addendum (2016).
- C. AHRI 520 - Performance Rating of Positive Displacement Condensing Units 2004.
- D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2024.
- E. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems 2024.
- F. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.
- D. Design Data: Indicate refrigerant pipe sizing.
- E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- F. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Mitsubishi Electric Trane HVAC US LLC
- B. Daikin Comfort Technologies North America, Inc.
- C. York International Corporation / Johnson Controls
- D. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.02 SYSTEM DESIGN

- A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.
 - 1. Heating and Cooling: Air-source electric heat pump located in outdoor unit with evaporator.
 - 2. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.

2.03 INDOOR AIR HANDLING UNITS FOR DUCTLESS SYSTEMS

- A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, evaporator coil, and controls; wired for single power connection with control transformer.

- B. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
 - 1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.
 - 2. Manufacturer: System manufacturer.

2.04 OUTDOOR UNITS

- A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
 - 1. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.
 - 2. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
 - 3. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23.1 and UL 207.
 - 4. Sound Rating: 69 dBA, when measured in accordance with AHRI 270.
- B. Compressor: Hermetic, two speed 1800 and 3600 rpm, AHRI 520 resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high pressure control, motor overload protection, service valves and drier. Provide time delay control to prevent short cycling and rapid speed changes.
- C. Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.
 - 1. Condenser Fans: Direct-drive propeller type.
- D. Operating Controls:
 - 1. Control by room thermostat to maintain room temperature setting.
 - 2. Low Ambient Kit: Provide refrigerant pressure switch to cycle condenser fan on when condenser refrigerant pressure is above 285 psig and off when pressure drops below 140 psig for operation to 0 degrees F.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.
- B. Verify that proper power supply is available and in correct location.

3.02 INSTALLATION

- A. Install in accordance with NFPA 90A and NFPA 90B.
- B. Pipe drain from cooling coils to nearest floor drain.

END OF SECTION

SECTION 23 82 00
CONVECTION HEATING AND COOLING UNITS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Hydronic Unit Heaters.
- B. Hydronic Cabinet Unit Heaters.
- C. Fan Coil Units.
- D. Electric Unit Heaters.

1.02 RELATED REQUIREMENTS

- A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.
- B. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addendum (2011).
- C. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addendum (2011).
- D. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addendum (2011).
- E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.

1.03 REFERENCE STANDARDS

- A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Current Edition.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide typical catalog of information including arrangements.
- C. Shop Drawings:
 - 1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
 - 2. Indicate air coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
 - 3. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.
- E. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.01 HYDRONIC UNIT HEATERS

- A. Coils: Seamless copper tubing, silver brazed to steel headers, and with evenly spaced aluminum fins mechanically bonded to tubing.
- B. Perform factory run test under normal operating conditions, water, and steam flow rates.

- C. Casing: Minimum 18 gauge, 0.0478 inch thick sheet steel casing with threaded pipe connections for hanger rods for horizontal models and minimum 18 gauge, 0.0478 inch thick sheet steel top and bottom plates for vertical projection models.
- D. Finish: Factory applied baked primer coat.
- E. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard; horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.
- F. Manufacturers:
 - 1. Zehnder-Rittling; <https://zehnder-rittling.com/>
 - 2. Modine HVAC; <https://www.modinehvac.com/>
 - 3. Sterling; <https://www.sterlingheat.com/>
 - 4. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.02 HYDRONIC CABINET UNIT HEATERS

- A. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to Authority Having Jurisdiction as suitable for the purpose indicated.
- B. Coils:
 - 1. Evenly spaced aluminum fins mechanically bonded to copper tubes.
- C. Cabinet: Minimum 16 gauge, 0.0598 inch thick sheet steel front panel with exposed corners and edges rounded, easily removed panels, glass fiber insulation, integral air outlet, and inlet grilles.
- D. Finish: Factory applied baked primer coat on visible surfaces of enclosure or cabinet.
- E. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.
- F. Motor: Tap wound multiple speed permanent split capacitor with sleeve bearings, resiliently mounted.
- G. Control: Factory wired, solid state, infinite speed control, located in cabinet.
- H. Filter: Easily removed, 1 inch thick glass fiber throw-away type, located to filter air before coil.
- I. Manufacturers:
 - 1. Zehnder-Rittling; <https://zehnder-rittling.com/>
 - 2. Modine HVAC; <https://www.modinehvac.com/>
 - 3. Sterling; <https://www.sterlingheat.com/>
 - 4. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.03 FAN COIL UNITS

- A. Performance Data and Safety Requirements:
 - 1. Unit capacities certified in accordance with AHRI 440.
 - 2. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to Authority Having Jurisdiction as suitable for the purpose indicated.
 - 3. Insulation to comply with NFPA 90A requirements for flame spread and smoke generation.
 - 4. Equipment wiring to comply with requirements of NFPA 70.
- B. Required Directory Listings: AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI).
- C. Coils:
 - 1. Evenly spaced aluminum fins mechanically bonded to copper tubes.
 - 2. Water Coil: Suitable for working temperatures not less than 200 degrees F.
 - 3. Provide drain pan under cooling coil easily removable for cleaning.
- D. Horizontal Units:

1. Provide with a galvanized steel cabinet, easily removed panels, glass fiber insulation, and integral air outlet with minimum 18 gauge, 0.0478 inch thick sheet steel bottom panel.
2. Ducted Units: Provide with air inlet and outlet duct collars.
- E. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.
- F. Motor: Tap wound multiple speed permanent split capacitor with sleeve bearings, resiliently mounted.
- G. Controls:
 1. Provide units with control valves furnished by the fan coil unit manufacturer.
 2. Controls Interface:
 - a. 0-10 VDC motor speed controller.
- H. Filter: Easily removed 1 inch thick glass fiber throw-away type, located to filter air before coil.
- I. Manufacturers:
 1. Price Industries, Inc.
 2. Johnson Controls, Inc.
 3. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

2.04 ELECTRIC UNIT HEATERS

- A. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to Authority Having Jurisdiction as suitable for the purpose indicated.
- B. Assembly: Suitable for mounting from ceiling or structure above with built-in controls, thermal safety cut-out, and electric terminal box.
- C. The fan shall be five-bladed aluminum. The fan motor shall be totally enclosed.
- D. Fan control shall be of bimetallic, snap-action type and shall activate fan after heating element reaches operating temperature. The fan shall continue to operate after the thermostat is satisfied and until the heating element is cool.
- E. A thermal cutout shall be built into the system to shut off the heater in the event of overheating.
- F. A double-pole single throw disconnect switch shall be mounted on the housing for positive disconnect of power supply. Switch shall be completely concealed behind the faceplate.
- G. Heating Element shall be Nickel chromium resistance wire surrounded with magnesium oxide and sheathed in steel, spiral-finned tubes.
- H. Housing shall be designed for duty as a recessed rough-in box for either masonry or frame installations. Housing shall be 20- gauge galvanized steel and shall contain knockouts through which power leads are brought.
- I. Louvered faceplate shall be of 14-gauge cold-rolled steel, phosphatized, then electrostatically painted White by a powder coat process. A ¼-inch mesh screen shall be installed beneath the faceplate to deter the insertion of foreign objects. The face plate shall be secured to the heating unit with tamper-resistant screws.
- J. Unit shall be provided with integral built-in thermostat as well as low voltage control relay for building automation system control and integration.
- K. Manufacturers:
 1. Qmark / Marley Engineered Products.
 2. Indeco Heating Solutions.
 3. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are suitable for installation.
- B. Verify that field measurements are as indicated on drawings.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's recommendations.
- B. Install equipment exposed to finished areas after walls and ceilings are finished and painted.
- C. Do not damage equipment or finishes.
- D. Unit Heaters:
 - 1. Hang from building structure, with pipe hangers anchored to building, not from piping or electrical conduit.
 - 2. Mount as high as possible to maintain greatest headroom unless otherwise indicated.
- E. Cabinet Unit Heaters:
 - 1. Install as indicated.
 - 2. Coordinate to ensure correct recess size for recessed units.
- F. Fan Coil Units:
 - 1. Verify all surfaces and openings at unit location can suitably accommodate unit(s).
 - 2. Install in accordance with manufacturer's recommendations.
 - 3. Provide manual shut-off valve on hydronic supply side of coil and balancing valve with memory stop on return side.
 - 4. General piping installation requirements are specified in other Sections and drawings indicate general arrangement of piping, fittings, and specialties.
 - 5. Connect hydronic, condensate drain, and overflow drain piping to unit.

3.03 CLEANING

- A. After construction and painting is completed, clean exposed surfaces of units.
- B. Vacuum clean coils and inside of units.
- C. Touch-up marred or scratched surfaces of factory-finished cabinets using finish materials furnished by the manufacturer.
- D. Install new filters.

3.04 PROTECTION

- A. Provide finished cabinet units with protective covers during the balance of construction.

END OF SECTION

SECTION 23 83 00
RADIANT HEATING AND COOLING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Radiant heating hydronic piping.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 08 31 00 - Access Doors and Panels.
- C. Section 23 09 93 - Sequence of Operations for HVAC Controls.

1.03 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- B. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing 2022a, with Editorial Revision.
- C. ASTM F1281 - Standard Specification for Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe 2017, with Editorial Revision (2021).
- D. ASTM F1807 - Standard Specification for Metal Insert Fittings Utilizing a Copper Crimp Ring, or Alternate Stainless Steel Clamps, for SDR9 Cross-Linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing 2023.
- E. ASTM F1974 - Standard Specification for Metal Insert Fittings for Polyethylene/Aluminum/Polyethylene and Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene Composite Pressure Pipe 2023.
- F. DIN 4726 - Warm Water Surface Heating Systems and Radiator Connecting Systems - Plastics Piping Systems and Multilayer Piping Systems 2017.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
 - B. Product Data: Provide data for in-floor heating system products.
 - C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions of equipment and controls, installation instructions, maintenance and repair data, and parts listings.
 - D. Submit shop drawings indicating detailed layout of system, including equipment, tubing locations, loop lengths, critical dimensions, tubing/slab penetration details, fittings, and details for protected exposed PEX tubing. Provide pressure drops at design flow rates for all equipment including loops, manifolds, isolation valves, and control valves. Provide detailed flow, pressure, and electrical power requirements of radiant system pump.
 - E. Submit manufacturer's technical instructions including specific installation instructions for system installation in the specific construction of the radiant panel or slab. Include details at slab construction joints and expansion joints.
 - F. Submit installer's certifications of training for installation of PEX floor heating systems.
 - G. Submit data indicating tube sizing and panel performance at tube spacing and warm water temperatures selected.
 - H. Submit independent certification results for the tubing systems from a recognized testing laboratory.
-

- I. Submit catalog data on all supports, tube guides, spacers, fittings, and associated items necessary for the installation of the tubing and manifolds.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Deliver and store tubing and specialties in shipping containers with labeling in place. Do not expose to ultraviolet light for more than 90 days.
- C. Protect tubing and specialties from entry of contaminating material by installing tape or plugs in all open tube ends until installation and/or maintain tubing in the original shipping boxes or packaging until usage.
- D. Unprotected tubes shall not be dragged across the ground or concrete surfaces, and shall be stored on a flat surface with no sharp edges.
- E. Tube shall be protected from oil, grease, direct sunlight, paint, and other elements as recommended by manufacturer.

1.07 WARRANTY

- A. See Section 01 78 36 - Warranties, for additional warranty requirements.
- B. Provide 5 year manufacturer's warranty for tubing, connectors and manifolds.

PART 2 PRODUCTS

2.01 RADIANT-HEATING HYDRONIC PIPING

- A. Applications:
 1. Provide the following types of hydronic, radiant heating piping for the applications described:
 - a. Piping in Interior Reinforced Concrete Floors: PEX/AL/PEX.
 - b. Piping in Level Fill Concrete Floors (Not Reinforced): PEX/AL/PEX.
- B. Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX/AL/PEX) Pipe and Fittings:
 1. Manufacturers:
 - a. Viega LLC; www.viega.us/#sle.
 - b. Substitutions: See Section 01 25 13 - Product Substitution Procedures.
 2. Pipe Material: PEX plastic bonded to the inside and outside of a welded aluminum tube according to ASTM F1281.
 3. Oxygen Barrier: Limit oxygen diffusion through the pipe to maximum 0.0000436996 grains per cu ft/day at 104 degrees F according to DIN 4726.
 4. Fittings: ASTM F1974, metal insert fittings with split ring and compression nut (compression joint) or metal insert fittings with copper crimp rings (crimp joint).
 5. Flame Spread and Smoke Developed Indexes: 25 and 50 or less, respectively, when tested in accordance with ASTM E84.
 6. Pressure/Temperature Rating: Minimum 100 psig and 210 degrees F.
- C. Distribution Manifolds (Manufacturer's Standard):
 1. Manifold: Minimum 1 inch, brass, copper, or stainless steel.
 2. Main Shutoff Valves:
 - a. Factory installed on supply and return connections.
 - b. Two-piece brass or bronze body.
 - c. Ball: Chrome-plated bronze.
 - d. Seals: PTFE.
 - e. CWP Rating: 150 psig.
 - f. Maximum Operating Temperature: 225 degrees F.
 3. Manual Air Vents:
 - a. Body to consist of bronze or brass.

-
- b. Internal Parts: Nonferrous.
 - c. Operator: Key furnished with valve or screwdriver bit.
 - d. Inlet Connection: 1/2 inch.
 - e. Discharge Connection: 1/8 inch.
 - f. CWP Rating: 150 psig.
 - g. Maximum Operating Temperature: 225 degrees F.
 - 4. Balancing Valves:
 - a. Body: Provide plastic or bronze, plug or globe cartridge type.
 - b. Plug: EPDM.
 - c. Globe Cartridge and Washer: Brass with EPDM composition washer.
 - d. Seat: PTFE.
 - e. Visual Flow Indicator: Flowmeter with visible indication in a clear plastic cap at top of valve.
 - f. Differential Pressure Gauge Connections: Integral seals for portable meter to measure loss across calibrated orifice.
 - g. Handle Style: Knob, with memory stop to retain set position if used for shutoff.
 - h. CWP Rating: Minimum 125 psig.
 - i. Maximum Operating Temperature: 250 degrees F.
 - 5. Zone Control Valves:
 - a. Body: Provide brass or bronze, plug, globe, or cartridge type.
 - b. Plug: EPDM.
 - c. Globe Cartridge and Washer: Brass with EPDM composition washer.
 - d. Seat: PTFE.
 - e. Actuator: Replaceable electric motor.
 - f. CWP Rating: Minimum 125 psig.
 - g. Maximum Operating Temperature: 250 degrees F.
 - 6. Thermometers:
 - a. Mounted on supply and return connections.
 - b. Case: Dry type, metal or plastic, 2 inch diameter.
 - c. Element: Bi-metallic coil.
 - d. Movement: Mechanical, connecting element and pointer.
 - e. Dial: Satin-faced, non-reflective aluminum with permanently etched scale markings.
 - f. Pointer: Black metal.
 - g. Window: Plastic.
 - h. Connector: Rigid, back type.
 - i. Thermal System: Bi-metallic coil.
 - j. Accuracy: Plus or minus 1 percent of range or 1 scale division to maximum of 1.5 percent of range.
 - 7. Mounting Brackets: Provide copper, plastic, or rubber-clad steel, where in contact with manifold.
 - D. Manufacturers:
 - 1. Uponor
 - 2. Rehau
 - 3. Substitutions: See Section 01 25 13 - Product Substitution Procedures.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Hydronic Radiant Heating Piping:
 - 1. Examine surfaces and substrates to receive radiant heating piping for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - a. Ensure that surfaces and pipes in contact with radiant heating piping are free of burrs and sharp protrusions.
 - b. Ensure that surfaces and substrates are level and plumb.
-

2. Proceed with installation only after unsatisfactory conditions are corrected.

3.02 PREPARATION

- A. Clean all surfaces prior to installation.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's recommendations.
- B. Hydronic Radiant Heating Piping:
 1. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
 2. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 3. Install piping as indicated unless deviations to layout are approved on shop drawings or coordination drawings.
 4. Install radiant heating piping continuous from the manifold through the heated panel and back to the manifold without piping joints in heated panels.
 5. All fittings should be accessible for maintenance. Tubing loops shall be installed without splices, as a minimum, from the point at which the tubing enters the panel to the point at which it exits the panel. No splices shall occur underground.
 6. Connect radiant piping to manifold in a reverse-return arrangement.
 7. Do not bend pipes in radius smaller than manufacturer's minimum bend radius dimension.
 8. Comply with requirements in Sections 23 21 13 and 23 21 14 for pipes and connections to hydronic systems and for glycol-solution fill requirements.
 9. Piping in Interior Reinforced Concrete Floors:
 - a. Secure piping in concrete floors by attaching pipes to reinforcement using cable ties.
 - b. Space cable ties a maximum of 18 inches and at center of turns or bends.
 - c. Maintain 2 inch minimum cover.
 - d. Install a sleeve of 3/8 inch thick, foam type insulation or PE pipe around tubing and extending for a minimum of 10 inches on each side of slab joints to protect the tubing passing through expansion or control joints.
 - e. Maintain minimum 40 psig pressure in piping during concrete placement and continue for 24 hours after placement.
 10. Piping in Level Fill Concrete Floors (Not Reinforced):
 - a. Secure piping in concrete floors by attaching pipes to subfloor using tracks, clamps, or staples.
 - b. Space tracks, clamps, or staples a maximum of 18 inches on center and at center turn of bends.
 - c. Maintain 3/4 inch minimum cover.
 - d. Install a sleeve of 3/8 inch thick, foam type insulation or PE pipe around tubing and extending for a minimum of 10 inches on each side of slab joints to protect the tubing passing through expansion or control joints.
 - e. Maintain minimum 40 psig pressure in piping during the concrete pour and continue for 24 hours during curing.
 11. Revise locations and elevations from those indicated as required to suit field conditions and ensure integrity of piping and as approved by Architect.
 12. After system balancing has been completed, mark balancing valves to permanently indicate final position.
 13. Perform the following adjustments before operating the system:
 - a. Open valves to fully open position.
 - b. Check operation of automatic valves.
 - c. Set temperature controls so all zones call for full flow.
 - d. Purge air from piping.

- C. Provide warning labels in mechanical equipment spaces to alert future building remodelers of the presence of in-slab tubing.
- D. Any deviations from shop drawing layout must be accurately dimensioned for Owner's records.
- E. Contractor shall take detailed photographs of installation and provide to owner as part of record documents in digital format for future reference.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 45 16 - Field Quality Control Procedures, for additional requirements.
- B. Provide manufacturer's field representative to test, inspect, instruct, and observe.
- C. Hydronic Radiant Heating Piping:
 - 1. Prepare radiant heating piping for testing as follows:
 - a. Open all isolation valves and close bypass valves.
 - b. Open and verify operation of zone control valves.
 - c. Flush with clean water and clean strainers.
 - 2. Perform the following tests and inspections with the assistance of a factory authorized service representative:
 - a. Leak Test:
 - 1) After installation, charge system and test for leaks.
 - 2) Subject piping to hydrostatic test pressure that is not less than 1.5 times the design pressure but not more than 100 psig for a period of 8 hours.
 - 3) Repair leaks and retest until no leaks exist.
 - b. Test and adjust controls and safeties.
 - c. Replace damaged and malfunctioning controls and equipment.
 - d. Notify owner 24 hours prior to pressure testing.
 - 3. Execute, complete, and pass required radiant-heating piping tests and inspections to accept installed piping.
 - 4. Prepare test and inspection reports.
 - 5. Protect hydronic piping system from damage during construction.

3.05 PROTECTION

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

END OF SECTION

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Single conductor building wire.
- B. Service entrance cable.
- C. Metal-clad cable.
- D. Power and control tray cable.
- E. Variable-frequency drive cable.
- F. Photovoltaic wire.
- G. Wiring connectors.
- H. Electrical tape.
- I. Heat shrink tubing.
- J. Oxide inhibiting compound.
- K. Wire pulling lubricant.
- L. Cable ties.
- M. Firestop sleeves.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 21 00 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conductors.
- E. Section 26 31 00 - Photovoltaic Collectors: Additional wiring requirements for photovoltaic systems.
- F. Section 28 46 00 - Fire Detection and Alarm: Fire alarm system conductors and cables.

1.03 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire 2013 (Reapproved 2018).
 - B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft 2023.
 - C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes 2010, with Editorial Revision (2020).
 - D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation 2004 (Reapproved 2020).
 - E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape 2017.
 - F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes 2020.
 - G. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
 - H. NECA 120 - Standard for Installing Armored Cable (AC) and Type Metal-Clad (MC) Cable 2018.
 - I. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy 2021.
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- J. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.
- K. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. NFPA 79 - Electrical Standard for Industrial Machinery 2021.
- 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 486A-486B - Wire Connectors Current Edition, Including All Revisions.
- P. UL 486C - Splicing Wire Connectors Current Edition, Including All Revisions.
- Q. UL 486D - Sealed Wire Connector Systems Current Edition, Including All Revisions.
- R. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape Current Edition, Including All Revisions.
- S. UL 854 - Service-Entrance Cables Current Edition, Including All Revisions.
- T. UL 1277 - Electrical Power and Control Tray Cables with Optional Optical-Fiber Members Current Edition, Including All Revisions.
- U. UL 1569 - Metal-Clad Cables Current Edition, Including All Revisions.
- V. UL 2277 - Outline of Investigation for Flexible Motor Supply Cable and Wind Turbine Tray Cable Current Edition, Including All Revisions.
- W. UL 4703 - Standard for Photovoltaic Wire Current Edition, Including All Revisions.

1.04 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 the installation of direct burial cable with other trades to avoid conflicts with piping or other potential conflicts.
 - 3. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
 - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required 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. Sustainable Design Documentation: Submit manufacturer's product data on conductor and cable showing compliance with specified lead content requirements.
- D. Manufactured Wiring System Shop Drawings: Provide plan views indicating proposed system layout with components identified; indicate branch circuit connections.
- E. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring gutters, enclosures, etc. to accommodate substituted conductors.
- F. Field Quality Control Test Reports.

- G. 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.
- H. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements for City of Madison additional provisions.
 - 2. Extra Manufactured Wiring Systems Cable Assemblies: One of each configuration, 6 feet length.

1.06 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. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 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 power and control tray cable or metal-clad cable for installation in cable tray.
 - b. Use variable-frequency drive cable for connection between variable-frequency motor controllers and associated motors.
- C. Nonmetallic-sheathed cable is not permitted.
- D. Underground feeder and branch-circuit cable is not permitted.
- E. Service entrance cable is permitted only as follows:
 - 1. Where not otherwise restricted, may be used:
 - a. For overhead service drop, installed in raceway to service head.
 - b. For underground service entrance, installed in raceway.
- F. Armored cable is not permitted.
- G. Metal-clad cable is permitted only as follows:
 - 1. Where not otherwise restricted, may be used:
 - a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.

- 1) Maximum Length: 6 feet.
2. In addition to other applicable restrictions, may not be used:
 - a. Unless approved by Owner.
 - b. Where not approved for use by the authority having jurisdiction.
 - c. Where exposed to view.
 - d. Where exposed to damage.
 - e. For damp, wet, or corrosive locations, unless provided with a PVC jacket listed as suitable for those locations.
 - f. For isolated ground circuits, unless provided with an additional isolated/insulated grounding conductor.

2.02 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. Provide new conductors and cables manufactured not more than one year prior to installation.
- D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- E. Comply with NEMA WC 70.
- F. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- G. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- H. Conductors for Grounding and Bonding: Also comply with Section 26 05 26.
- I. Conductors and Cables Installed in Cable Tray: Listed and labeled as suitable for cable tray use.
- J. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.
- K. 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/B787M unless otherwise indicated.
 3. Tinned Copper Conductors: Comply with ASTM B33.
- L. Minimum Conductor Size:
 1. Branch Circuits: 12 AWG.
 - a. Exceptions:
 - 1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
 - 2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
 - 3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.
 2. Control Circuits: 14 AWG.
- M. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- N. 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: Integrally colored insulation.
 - a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
 3. Color Code:
 - a. 208Y/120 V, 3 Phase, 4 Wire System:

- 1) Phase A: Black.
- 2) Phase B: Red.
- 3) Phase C: Blue.
- 4) Neutral/Grounded: White.
- b. Equipment Ground, All Systems: Green.
- c. Isolated Ground, All Systems: Green with yellow stripe.
- d. Travelers for 3-Way and 4-Way Switching: Pink.
- e. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.
- f. For control circuits, comply with manufacturer's recommended color code.

2.03 SINGLE CONDUCTOR BUILDING WIRE

- A. Manufacturers:
 1. Copper Building Wire:
 - a. Cerro Wire LLC: www.cerrowire.com/#sle.
 - b. Encore Wire Corporation: www.encorewire.com/#sle.
 - c. General Cable Technologies Corporation: www.generalcable.com/#sle.
 - d. Service Wire Co: www.servicewire.com/#sle.
 - e. Southwire Company: www.southwire.com/#sle.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.
- 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.
 2. Control Circuits: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
 - a. Size 4 AWG and Larger: Type XHHW-2.
 - b. Installed Underground: Type XHHW-2.
 - c. Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Approved suitable type for luminaires with labeled maximum temperature greater than 90 degrees C.

2.04 SERVICE ENTRANCE CABLE

- A. Manufacturers:
 1. Copper Service Entrance Cable:
 - a. Cerro Wire LLC: www.cerrowire.com/#sle.
 - b. Encore Wire Corporation: www.encorewire.com/#sle.
 - c. Service Wire Co: www.servicewire.com/#sle.
 - d. Southwire Company: www.southwire.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Service Entrance Cable for Above-Ground Use: NFPA 70, Type SE multiple-conductor cable listed and labeled as complying with UL 854, Style R.
- C. Service Entrance Cable for Underground Use: NFPA 70, Type USE single-conductor cable listed and labeled as complying with UL 854, Type USE-2, and with UL 44 Type RHH/RHW-2.
- D. Conductor Stranding: Stranded.

E. Insulation Voltage Rating: 600 V.

2.05 METAL-CLAD CABLE

A. Manufacturers:

1. AFC Cable Systems Inc: www.afcweb.com/#sle.
2. Encore Wire Corporation: www.encorewire.com/#sle.
3. Service Wire Co: www.servicewire.com/#sle.
4. Southwire Company: www.southwire.com/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.

C. Conductor Stranding:

1. Size 10 AWG and Smaller: Solid.
2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.

F. Provide dedicated neutral conductor for each phase conductor where indicated or required.

G. Grounding: Full-size integral equipment grounding conductor.

1. Provide additional isolated/insulated grounding conductor where indicated or required.

H. Armor: Steel, interlocked tape.

I. Provide PVC jacket applied over cable armor where indicated or required for environment of installed location.

2.06 POWER AND CONTROL TRAY CABLE

A. Manufacturers:

1. Encore Wire Corporation: www.encorewire.com/#sle.
2. General Cable Technologies Corporation: www.generalcable.com/#sle.
3. Okonite: www.okonite.com/#sle.
4. Service Wire Co: www.servicewire.com/#sle.
5. Southwire Company: www.southwire.com/#sle.
6. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type TC cable listed and labeled as complying with UL 1277.

C. Where exposed run cable is indicated between cable tray and utilization equipment in qualifying industrial establishments as determined by authorities having jurisdiction, provide tray cable marked as Type TC-ER in accordance with NFPA 70.

D. Conductor Stranding: Stranded.

E. Insulation Voltage Rating: 600 V.

F. Insulation: Type XHHW or XHHW-2.

G. Grounding: Full-size integral equipment grounding conductor.

H. Jacket: PVC or Chlorinated Polyethylene (CPE).

2.07 VARIABLE-FREQUENCY DRIVE CABLE

A. Manufacturers:

1. Service Wire Co; ServiceDrive: www.servicewire.com/#sle.
2. Substitutions: See Section 01 60 00 - Product Requirements.

- B. Description: Flexible motor supply cable listed and labeled as complying with UL 2277 in accordance with NFPA 79; specifically designed for use with variable frequency drives and associated nonlinear power distortions.
- C. Conductor Stranding: Stranded.
- D. Insulation Voltage Rating: 1000 V.
- E. Insulation: Use only thermoset insulation types; thermoplastic insulation types are not permitted.
- F. Grounding: Full-size integral equipment grounding conductor or symmetrical arrangement of multiple conductors of equivalent size.
- G. Provide metallic shielding.
- H. Jacket: PVC or Chlorinated Polyethylene (CPE).

2.08 PHOTOVOLTAIC WIRE

- A. Manufacturers:
 - 1. Service Wire Co; ServiceSolar: www.servicewire.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: Sunlight-resistant, single-conductor, insulated photovoltaic wire listed and labeled as complying with UL 4703; specifically designed for interconnection wiring of photovoltaic power systems in accordance with NFPA 70.
- C. Conductor Stranding: Stranded.
- D. Insulation Voltage Rating: As required for photovoltaic power system voltage.

2.09 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 05 26.
- C. Wiring Connectors for Splices and Taps:
 - 1. Copper Conductors Size 8 AWG and Smaller: Use mechanical 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. Mechanical Connectors: Provide bolted type or set-screw type.

1. Manufacturers:
 - a. Burndy LLC: www.burndy.com/#sle.
 - b. IlSCO: www.ilsco.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- H. Compression Connectors: Provide circumferential type or hex type crimp configuration.
 1. Manufacturers:
 - a. Burndy LLC: www.burndy.com/#sle.
 - b. IlSCO: www.ilsco.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- I. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
 1. Manufacturers:
 - a. Burndy LLC: www.burndy.com/#sle.
 - b. IlSCO: www.ilsco.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

2.10 ACCESSORIES

- A. Electrical Tape:
 1. Manufacturers:
 - a. 3M: www.3m.com/#sle.
 - b. Plymouth Rubber Europa: www.plymouthrubber.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
 3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
 4. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.
- B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
 1. Manufacturers:
 - a. 3M: www.3m.com/#sle.
 - b. Burndy LLC: www.burndy.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
 1. Manufacturers:
 - a. Burndy LLC: www.burndy.com/#sle.
 - b. Ideal Industries, Inc: www.idealindustries.com/#sle.
 - c. IlSCO: www.ilsco.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.

1. Manufacturers:
 - a. 3M: www.3m.com/#sle.
 - b. American Polywater Corporation: www.polywater.com/#sle.
 - c. Ideal Industries, Inc: www.idealindustries.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Cable Ties: Material and tensile strength rating suitable for application.
 1. Manufacturers:
 - a. Burndy LLC: www.burndy.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for cables and roofing system to be installed; designed to accommodate existing penetrations where applicable.
 1. Products:
 - a. Menzies Metal Products; Electrical Roof Stack and Cap: www.menzies-metal.com/#sle.
 - b. Menzies Metal Products; Electrical Retro Box: www.menzies-metal.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- G. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
 1. Products:
 - a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: www.holdrite.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 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 indicated.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

- A. Circuiting Requirements:
 1. Unless dimensioned, circuit routing indicated is diagrammatic.
 2. When circuit destination is indicated without specific routing, determine exact routing required.
 3. Include circuit lengths required to install connected devices within 10 ft of location indicated.
 4. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
 5. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
 6. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated 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.

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7. 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.
 8. Provide oversized neutral/grounded conductors where indicated and as specified below.
 - a. Provide 200 percent rated neutral for feeders fed from K-rated transformers.
 - b. Provide 200 percent rated neutral for feeders serving panelboards with 200 percent rated neutral bus.
 - B. Install products in accordance with manufacturer's instructions.
 - C. Perform work in accordance with NECA 1 (general workmanship).
 - D. Install metal-clad cable (Type MC) in accordance with NECA 120.
 - 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. Installation in Cable Tray: Also comply with Section 26 05 36.
 - G. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
 - H. 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.
 2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.
 - I. Terminate cables using suitable fittings.
 1. Metal-Clad Cable (Type MC):
 - a. Use listed fittings.
 - b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
 - J. Variable-Frequency Drive Cable: Terminate shielding at both variable-frequency motor controller and associated motor using glands or termination kits recommended by manufacturer.
 - K. Install conductors with a minimum of 12 inches of slack at each outlet.
 - L. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.
 - M. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
 - N. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
 - O. 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.
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4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. 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.
- P. 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. Dry Locations: Use insulating covers specifically designed for the connectors or heat shrink tubing.
 2. Damp Locations: Use insulating covers specifically designed for the connectors or heat shrink tubing.
 - a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
 3. Wet Locations: Use heat shrink tubing.
- Q. Insulate ends of spare conductors using vinyl insulating electrical tape.
- R. 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.
- S. Identify conductors and cables in accordance with Section 26 05 53.
- T. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- U. 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.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 45 16 - Field Quality Control Procedures for City of Madison additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
 1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground bars.
- E. Ground rod electrodes.
- F. Ground plate electrodes.
- G. Ground enhancement material.
- H. Ground access wells.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
 - 1. Includes oxide inhibiting compound.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- C. Section 26 31 00 - Photovoltaic Collectors: Additional grounding and bonding requirements for photovoltaic systems.
- D. Section 26 56 00 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.

1.03 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 2015.
- C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings 2022.
- D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.
- E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. NFPA 780 - Standard for the Installation of Lightning Protection Systems 2023.
- G. UL 467 - Grounding and Bonding Equipment Current Edition, Including All Revisions.

1.04 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 of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
- C. Shop Drawings:
 - 1. Indicate proposed arrangement for signal reference grids. Include locations of items to be bonded and methods of connection.
- D. Manufacturer's 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. Field quality control test reports.
- F. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.06 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. Installer Qualifications for Signal Reference Grids: Company with minimum five years documented experience with high frequency grounding systems.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS**2.01 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. 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.

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3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.
- 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 at an accessible location not more than 5 feet 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 In-Ground Support Structure:
 - a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
 4. Concrete-Encased Electrode:
 - a. Provide connection to concrete-encased electrode consisting of not less than 20 feet 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 Ring:
 - a. Provide a ground ring encircling the building or structure consisting of bare copper conductor not less than 2 AWG in direct contact with earth, installed at a depth of not less than 30 inches.
 - b. Where location is not indicated, locate ground ring conductor at least 24 inches outside building perimeter foundation.
 - c. Provide ground enhancement material around conductor where indicated.
 - d. Provide connection from ground ring conductor to:
 - 1) Perimeter columns of metal building frame.
 - 2) Ground rod electrodes located as indicated.
 6. 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 from each other and any other ground electrode.
 - c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
 - d. Provide ground enhancement material around electrode where indicated.
 - e. Provide ground access well for each electrode.
 7. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
 8. 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 4 by 12 inches unless otherwise indicated or required.
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- 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 above finished floor unless otherwise indicated.
 - 9. Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in NFPA 70.
 - 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. Separately Derived System Grounding:
 - 1. Separately derived systems include, but are not limited to:
 - a. Transformers (except autotransformers such as buck-boost transformers).
 - b. Uninterruptible power supplies (UPS), when configured as separately derived systems.
 - c. Generators, when neutral is switched in the transfer switch.
 - 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. Where common grounding electrode conductor ground riser is used for tap connections to multiple separately derived systems, provide bonding jumper to connect the metal building frame and metal water piping in the area served by the derived system to the common grounding electrode conductor.
 - 5. Outdoor Source: Where the source of the separately derived system is located outside the building or structure supplied, provide connection to grounding electrode at source in accordance with NFPA 70.
 - 6. 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.
 - 7. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.
 - I. 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.
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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.
 - b. Metal gas piping.
 - c. Metal process piping.
 8. Provide bonding for interior metal air ducts.
 9. Provide bonding for metal building frame.
 10. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.
 11. Provide bonding and equipment grounding for pools and fountains and associated equipment in accordance with NFPA 70.
- J. Isolated Ground System:
1. Where isolated ground receptacles or other isolated ground connections are indicated, provide separate isolated/insulated equipment grounding conductors.
 2. Connect isolated/insulated equipment grounding conductors only to separate isolated/insulated equipment ground busses.
 3. Connect the isolated/insulated equipment grounding conductors to the solidly bonded equipment ground bus only at the service disconnect or separately derived system disconnect. Do not make any other connections between isolated ground system and normal equipment ground system on the load side of this connection.
- 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 trade size unless otherwise indicated or required.
 - c. Ground Bar Size: 1/4 by 4 by 12 inches unless otherwise indicated or required.
 - d. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.
- L. Pole-Mounted Luminaires: Also comply with Section 26 56 00.

2.02 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 05 26:
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 for underground, concealed and other inaccessible connections.
 - a. Exceptions:

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- 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/#sle.
 - b. Burndy LLC: www.burndy.com/#sle.
 - c. Harger Lightning & Grounding: www.harger.com/#sle.
 - d. Thomas & Betts Corporation: www.tnb.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
 5. Manufacturers - Exothermic Welded Connections:
 - a. Burndy LLC: www.burndy.com/#sle.
 - b. Cadweld, a brand of Erico International Corporation: www.erico.com/#sle.
 - c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Ground Bars:
1. Description: Copper rectangular ground bars with mounting brackets and insulators.
 2. Size: As indicated.
 3. Holes for Connections: As indicated or as required for connections to be made.
 4. Manufacturers:
 - a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
 - b. Erico International Corporation: www.erico.com/#sle.
 - c. Harger Lightning & Grounding: www.harger.com/#sle.
 - d. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Ground Rod Electrodes:
1. Comply with NEMA GR 1.
 2. Material: Copper-bonded (copper-clad) steel.
 3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.
 4. Where rod lengths of greater than 10 feet are indicated or otherwise required, sectionalized ground rods may be used.
 5. Manufacturers:
 - a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
 - b. Erico International Corporation: www.erico.com/#sle.
 - c. Galvan Industries, Inc: www.galvanelectrical.com/#sle.
 - d. Harger Lightning & Grounding: www.harger.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Ground Plate Electrodes:
1. Material: Copper.
 2. Size: 24 by 24 by 1/4 inches, unless otherwise indicated.
 3. Manufacturers:
 - a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
 - b. Erico International Corporation: www.erico.com/#sle.
 - c. Harger Lightning & Grounding: www.harger.com/#sle.
 - d. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.
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- e. Substitutions: See Section 01 60 00 - Product Requirements.
- G. Ground Enhancement Material:
 - 1. Description: Factory-mixed conductive material designed for permanent and maintenance-free improvement of grounding effectiveness by lowering resistivity.
 - 2. Resistivity: Not more than 20 ohm-cm in final installed form.
 - 3. Manufacturers:
 - a. Erico International Corporation: www.erico.com/#sle.
 - b. Harger Lightning & Grounding: www.harger.com/#sle.
 - c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- H. Ground Access Wells:
 - 1. Description: Open bottom round or rectangular well with access cover for testing and inspection; suitable for the expected load at the installed location.
 - a. Areas Exposed to Vehicular Traffic: Rated for not less than 5000 pounds vertical design load.
 - 2. Size: As required to provide adequate access for testing and inspection, but not less than minimum size requirements specified.
 - a. Round Wells: Not less than 8 inches in diameter.
 - b. Rectangular Wells: Not less than 12 by 12 inches.
 - 3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 10 inches.
 - 4. Cover: Factory-identified by permanent means with word "GROUND".
 - 5. Manufacturers:
 - a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
 - b. Erico International Corporation: www.erico.com/#sle.
 - c. Harger Lightning & Grounding: www.harger.com/#sle.
 - d. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- I. Oxide Inhibiting Compound: Comply with Section 26 05 19.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- 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 below finished grade.
 - 2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.
- D. Ground Plate Electrodes: Unless otherwise indicated, install ground plate electrodes at a depth of not less than 30 inches.

- E. 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.
- F. Identify grounding and bonding system components in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - 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 7.13.
- 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

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 05 33.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- C. Section 26 05 33.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
- D. Section 26 31 00 - Photovoltaic Collectors: Photovoltaic module mounting systems.
- E. Section 26 51 00 - Interior Lighting: Additional support and attachment requirements for interior luminaires.
- F. Section 26 56 00 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2023.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2023.
- D. MFMA-4 - Metal Framing Standards Publication 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- F. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 5B - Strut-Type Channel Raceways and Fittings Current Edition, Including All Revisions.

1.04 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 of any conflicts with or deviations from 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 in accordance with Section 03 30 00.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete and masonry anchors.
 1. Fiberglass Channel (Strut) Framing Systems: Include requirements for strength derating according to ambient temperature.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
- D. Derating Calculations for Fiberglass Channel (Strut) Framing Systems: Indicate load ratings adjusted for applicable service conditions.
- E. Evaluation Reports: For products specified as requiring evaluation and recognition by ICC Evaluation Service, LLC (ICC-ES), provide current ICC-ES evaluation reports upon request.
- F. Installer's Qualification Statement: Include evidence of compliance with specified requirements.
- G. Manufacturer's 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.

1.06 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable building code.
- C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 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. 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. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
 6. 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.

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- 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. Components for Vibration Isolation and/or Seismic Controls: Comply with Section 26 05 48.
 - C. 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.
 - 3. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Erico International Corporation: www.erico.com/#sle.
 - c. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
 - e. Thomas & Betts Corporation: www.tnb.com/#sle.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.
 - 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/#sle.
 - b. Erico International Corporation: www.erico.com/#sle.
 - c. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
 - e. Thomas & Betts Corporation: www.tnb.com/#sle.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.
 - 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 gauge, 0.1046 inch.
 - 5. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
 - 6. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Thomas & Betts Corporation: www.tnb.com/#sle.
 - c. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - e. 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 diameter.
 - b. Busway Supports: 1/2 inch diameter.
 - c. Single Conduit up to 1 inch (27 mm) trade size: 1/4 inch diameter.
 - d. Single Conduit larger than 1 inch (27 mm) trade size: 3/8 inch diameter.
 - e. Trapeze Support for Multiple Conduits: 3/8 inch diameter.
 - f. Outlet Boxes: 1/4 inch diameter.
 - g. Luminaires: 1/4 inch diameter.
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- 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 under supported component to top of roofing.
 4. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Erico International Corporation: www.erico.com/#sle.
 - c. PHP Systems/Design: www.phpsd.com/#sle.
 - d. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- 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. Hammer-driven anchors and fasteners are not permitted.
 - a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction (when specified).
 12. 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. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.
 - d. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
 13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
 14. Manufacturers - Mechanical Anchors:
 - a. Hilti, Inc: www.us.hilti.com/#sle.
 - b. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
 - c. Powers Fasteners, Inc: www.powers.com/#sle.
 - d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
 - B. Verify that mounting surfaces are ready to receive support and attachment components.
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- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- 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. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- F. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- H. Provide required vibration isolation and/or seismic controls in accordance with Section 26 05 48.
- I. Field-Welding (where approved by Architect): Comply with Section 05 50 00.
- J. 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 high concrete pad constructed in accordance with Section 03 30 00.
 - 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- K. Conduit Support and Attachment: Also comply with Section 26 05 33.13.
- L. Cable Tray Support and Attachment: Also comply with Section 26 05 36.
- M. Box Support and Attachment: Also comply with Section 26 05 33.16.
- N. Interior Luminaire Support and Attachment: Also comply with Section 26 51 00.
- O. Exterior Luminaire Support and Attachment: Also comply with Section 26 56 00.
- P. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- Q. Secure fasteners according to manufacturer's recommended torque settings.
- R. Remove temporary supports.
- S. 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.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 45 16 - Field Quality Control Procedures for City of Madison 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 05 33.13
CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Aluminum rigid metal conduit (RMC).
- C. Intermediate metal conduit (IMC).
- D. PVC-coated galvanized steel rigid metal conduit (RMC).
- E. Flexible metal conduit (FMC).
- F. Liquidtight flexible metal conduit (LFMC).
- G. Electrical metallic tubing (EMT).
- H. Rigid polyvinyl chloride (PVC) conduit.
- I. Electrical nonmetallic tubing (ENT).
- J. Liquidtight flexible nonmetallic conduit (LFNC).
- K. Reinforced thermosetting resin conduit (RTRC).
- L. Conduit fittings.
- M. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete encasement of conduits.
- B. Section 07 84 00 - Firestopping.
- C. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Metal clad cable (Type MC), armored cable (Type AC), and manufactured wiring systems, including uses permitted.
- D. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 1. Includes additional requirements for fittings for grounding and bonding.
- E. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- F. Section 26 05 33.16 - Boxes for Electrical Systems.
- G. Section 26 05 33.23 - Surface Raceways for Electrical Systems.
- H. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
- I. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- J. Section 27 00 05 - Communications Cabling: Additional requirements for communications systems conduits.
- K. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.

1.03 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC) 2020.
 - B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S) 2020.
 - C. ANSI C80.5 - American National Standard for Electrical Rigid Metal Conduit -- Aluminum (ERMC-A) 2020.
 - D. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit 2018.
 - E. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
 - F. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT) 2020.
 - G. NECA 102 - Standard for Installing Aluminum Rigid Metal Conduit 2004.
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- H. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC) 2017.
- I. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.
- J. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit 2018.
- K. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit 2020.
- L. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing 2021.
- M. NEMA TC 13 - Electrical Nonmetallic Tubing (ENT) 2014 (Reaffirmed 2019).
- N. NEMA TC 14 (SERIES) - Reinforced Thermosetting Resin Conduit and Fittings Series 2015.
- O. NEMA TC 14.AG - Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings 2015 (Reaffirmed 2021).
- P. NEMA TC 14.BG - Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings 2015 (Reaffirmed 2020).
- Q. NEMA TC 14.XW - Extra Heavy Wall Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings 2015 (Reaffirmed 2021).
- R. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- S. UL 1 - Flexible Metal Conduit Current Edition, Including All Revisions.
- T. UL 6 - Electrical Rigid Metal Conduit-Steel Current Edition, Including All Revisions.
- U. UL 6A - Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel Current Edition, Including All Revisions.
- V. UL 360 - Liquid-Tight Flexible Metal Conduit Current Edition, Including All Revisions.
- W. UL 514B - Conduit, Tubing, and Cable Fittings Current Edition, Including All Revisions.
- X. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings Current Edition, Including All Revisions.
- Y. UL 797 - Electrical Metallic Tubing-Steel Current Edition, Including All Revisions.
- Z. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations Current Edition, Including All Revisions.
- AA. UL 1242 - Electrical Intermediate Metal Conduit-Steel Current Edition, Including All Revisions.
- BB. UL 1653 - Electrical Nonmetallic Tubing Current Edition, Including All Revisions.
- CC. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit Current Edition, Including All Revisions.
- DD. UL 2420 - Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings Current Edition, Including All Revisions.
- EE. UL 2515 - Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings Current Edition, Including All Revisions.
- FF. UL 2515A - Standard for Supplemental Requirements for Extra Heavy Wall Reinforced Thermosetting Resin Conduit (RTRC) and Fittings Current Edition, Including All Revisions.

1.04 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 of any conflicts with or deviations from 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.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.
- C. Shop Drawings:
1. Indicate proposed arrangement for conduits to be installed within structural concrete slabs, where permitted.
 2. Include proposed locations of roof penetrations and proposed methods for sealing.
- D. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2 inch (53 mm) trade size and larger.

1.06 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. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 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 PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
 2. Exterior, Direct-Buried: Use intermediate metallic conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
 3. Exterior, Embedded Within Concrete: Use PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
 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 PVC-coated galvanized steel rigid metal conduit elbows for bends.

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6. Where steel conduit is installed in direct contact with earth where soil has a resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape to provide supplementary corrosion protection or use reinforced thermosetting resin conduit (RTRC).
 7. Where steel conduit emerges from concrete into soil, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches on either side of where conduit emerges or use PVC-coated galvanized steel rigid metal conduit.
- D. Embedded Within Concrete:
1. Within Slab on Grade (within structural slabs only where approved by Structural Engineer): Use PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
 2. Within Slab Above Ground (within structural slabs only where approved by Structural Engineer): Use PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
 3. Within Concrete Walls Above Ground: Use PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
 4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from concrete.
 5. Where electrical metallic tubing (EMT) emerges from concrete into salt air, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches on either side of where conduit emerges or use PVC-coated galvanized steel rigid metal conduit.
- E. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- F. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- G. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- H. Interior, Damp or Wet Locations: Use PVC-coated galvanized steel rigid metal conduit.
- I. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
1. Locations subject to physical damage include, but are not limited to:
 - a. Where exposed below 8 feet, except within electrical and communication rooms or closets.
 - b. Where exposed below 20 feet in warehouse areas.
- K. Exposed, Exterior: Use PVC-coated galvanized steel rigid metal conduit.
- L. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
- M. Corrosive Locations Above Ground: Use PVC-coated galvanized steel rigid metal conduit, aluminum rigid metal conduit, or reinforced thermosetting resin conduit (RTRC).
1. Corrosive locations include, but are not limited to:
 - a. Cooling towers.
- N. Hazardous (Classified) Locations: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), aluminum rigid metal conduit, or PVC-coated galvanized steel rigid metal conduit.
- O. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
1. Maximum Length: 6 feet.
- P. Connections to Vibrating Equipment:
1. Dry Locations: Use flexible metal conduit.
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2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
3. Maximum Length: 6 feet unless otherwise indicated.
4. Vibrating equipment includes, but is not limited to:
 - a. Transformers.
 - b. Motors.

Q. Fished in Existing Walls, Where Necessary: Use flexible metal conduit.

2.02 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. Electrical Service Conduits: Also comply with Section 26 21 00.
- C. Communications Systems Conduits: Also comply with Section 27 00 05.
- D. Fittings for Grounding and Bonding: Also comply with Section 26 05 26.
- E. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
- F. Provide products listed, classified, and labeled as suitable for the purpose intended.
- G. Minimum Conduit Size, Unless Otherwise Indicated:
 1. Branch Circuits: 3/4 inch (21 mm) trade size.
 2. Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
 3. Control Circuits: 1/2 inch (16 mm) trade size.
 4. Flexible Connections to Luminaires: 3/8 inch (12 mm) trade size.
 5. Underground, Interior: 3/4 inch (21 mm) trade size.
 6. Underground, Exterior: 1 inch (27 mm) trade size.
- H. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 2. Nucor Tubular Products: www.nucortubular.com/#sle.
 3. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
 4. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
 5. Substitutions: See Section 01 60 00 - Product Requirements.
- 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/#sle.
 - b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
 4. Material: Use steel.
 - a. Do not use die cast zinc fittings.
 5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.04 ALUMINUM RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 - 1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 - 2. Nucor Tubular Products: www.nucortubular.com/#sle.
 - 3. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
 - 4. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type RMC aluminum rigid metal conduit complying with ANSI C80.5 and listed and labeled as complying with UL 6A.
- C. Fittings:
 - 1. Manufacturers:
 - a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
 - b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
 - 4. Material: Use aluminum.
 - 5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.05 INTERMEDIATE METAL CONDUIT (IMC)

- A. Manufacturers:
 - 1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 - 2. Nucor Tubular Products: www.nucortubular.com/#sle.
 - 3. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
 - 4. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.
- C. Fittings:
 - 1. Manufacturers:
 - a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
 - b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
 - 4. Material: Use steel.
 - a. Do not use die cast zinc fittings.
 - 5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.06 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 - 1. Thomas & Betts Corporation: www.tnb.com/#sle.
 - 2. Calbond
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3. Robroy Industries: www.robroy.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.
- C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil.
- D. Interior Coating: Urethane, minimum thickness of 2 mil.
- E. PVC-Coated Fittings:
 1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
 2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
 3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
 4. Material: Use steel or malleable iron.
 5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil.
 6. Interior Coating: Urethane, minimum thickness of 2 mil.
- F. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil.

2.07 FLEXIBLE METAL CONDUIT (FMC)

- A. Manufacturers:
 1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
 2. Electri-Flex Company: www.electriflex.com/#sle.
 3. International Metal Hose: www.metalhose.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- 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/#sle.
 - b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 3. Material: Use steel.
 - a. Do not use die cast zinc fittings.

2.08 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Manufacturers:
 1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
 2. Electri-Flex Company: www.electriflex.com/#sle.
 3. International Metal Hose: www.metalhose.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- 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/#sle.
 - b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel.
 - a. Do not use die cast zinc fittings.

2.09 ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 2. Nucor Tubular Products: www.nucortubular/#sle.
 3. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
 4. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
 5. Substitutions: See Section 01 60 00 - Product Requirements.
- 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/#sle.
 - b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 3. Material: Use steel.
 - a. Do not use die cast zinc fittings.
 4. Connectors and Couplings: Use compression (gland) or set-screw type.
 - a. Do not use indenter 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 acceptable.

2.10 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Manufacturers:
 1. Cantex Inc: www.cantexinc.com/#sle.
 2. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com/#sle.
 3. JM Eagle: www.jmeagle.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- 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.

2.11 ELECTRICAL NONMETALLIC TUBING (ENT)

- A. Manufacturers:
 1. Cantex Inc: www.cantexinc.com/#sle.
 2. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com/#sle.
 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type ENT electrical nonmetallic tubing complying with NEMA TC 13 and listed and labeled as complying with UL 1653.

C. Fittings:

1. Manufacturer: Same as manufacturer of ENT to be connected.
2. Use solvent-welded type fittings.
3. Solvent-Welded Fittings: Rigid PVC fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; suitable for use with ENT.
4. Snap-on Fittings: Listed and labeled as complying with UL 651.

2.12 LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC)**A. Manufacturers:**

1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
2. Electri-Flex Company: www.electriflex.com/#sle.
3. International Metal Hose: www.metalhose.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type LFNC liquidtight flexible nonmetallic conduit listed and labeled as complying with UL 1660.**C. Fittings:**

1. Manufacturer: Same as manufacturer of conduit to be connected.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; suitable for the type of conduit to be connected.

2.13 REINFORCED THERMOSETTING RESIN CONDUIT (RTRC)**A. Manufacturers:**

1. Champion Fiberglass, Inc: www.championfiberglass.com.
2. FRE Composites: www.frecompositesinc.com
3. United Fiberglass of America, Inc: www.unitedfiberglass.com
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Applications:

1. Above Ground, Not Subject to Physical Damage: Use aboveground (AG), SW (Standard Wall) RTRC.
2. Above Ground, Subject to Physical Damage: Use aboveground (AG), XW (Extra Heavy Wall) RTRC.
3. Underground, Direct-Buried: Use belowground (BG), DB (direct burial) RTRC.
4. Underground, Embedded in Concrete: Use belowground (BG), EB (encased burial) RTRC or belowground (BG), DB (direct burial) RTRC.
5. Do not use RTRC in hazardous (classified) locations.

C. Description: NFPA 70, Type RTRC reinforced thermosetting resin conduit complying with NEMA TC 14 (SERIES).

1. Aboveground (AG) RTRC: Comply with NEMA TC 14.AG and list and label as complying with UL 2515.
2. Aboveground (AG), XW (Extra Heavy Wall) RTRC: Comply with NEMA TC 14.XW and list and label as complying with UL 2515A.
3. Belowground (BG) RTRC: Comply with NEMA TC 14.BG and list and label as complying with UL 2420.

D. Supports: Per manufacturer's recommendations.**E. Fittings:** Same type and manufacturer as conduit to be connected.

1. Cement-Tight Joints: Use bonded coupling or bell and spigot.
2. Cement- and Water-Tight Joints: Use adhesive and manufacturer's standard gaskets.

2.14 ACCESSORIES**A. Corrosion Protection Tape:** PVC-based, minimum thickness of 20 mil.

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- B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.
 - C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
 - D. Epoxy Adhesive for RTRC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
 - E. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.
 - F. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.
 - G. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.
 - H. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.
 - 1. Products:
 - a. Menzies Metal Products; Electrical Roof Stack and Cap: www.menzies-metal.com/#sle.
 - b. Menzies Metal Products; Electrical Retro Box: www.menzies-metal.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 - I. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.
 - 1. Manufacturers:
 - a. Quickflash Weatherproofing Products, Inc: www.quickflashproducts.com/#sle.
 - J. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
 - 1. Products:
 - a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: www.holdrite.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - K. Duct Bank Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for concrete encasement in open trench installation; suitable for the conduit/duct arrangement to be installed.
 - 1. Products:
 - a. Advance Products & Systems, LLC; Duct Bank Spacers: www.apsonline.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - L. Bore Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for installation within casing; furnished with roller wheels to facilitate installation, openings to facilitate grout flow, and holes for stabilization cable; suitable for the casing and conduit/duct arrangement to be installed.
 - 1. Products:
 - a. Advance Products & Systems, LLC; Bore Spacers: www.apsonline.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
 - B. Perform work in accordance with NECA 1 (general workmanship).
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- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
 - D. Install aluminum rigid metal conduit (RMC) in accordance with NECA 102.
 - E. Install intermediate metal conduit (IMC) in accordance with NECA 101.
 - F. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.
 - G. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
 - H. Install electrical nonmetallic tubing (ENT) in accordance with NECA 111.
 - I. Install liquidtight flexible nonmetallic conduit (LFNC) in accordance with NECA 111.
 - J. Conduit Routing:
 - 1. Unless dimensioned, conduit routing indicated is diagrammatic.
 - 2. When conduit destination is indicated without specific routing, 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 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 between conduits and piping for other systems.
 - 13. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
 - a. Heaters.
 - b. Hot water piping.
 - c. Flues.
 - 14. Group parallel conduits in the same area together on a common rack.
 - K. Conduit Support:
 - 1. Secure and support conduits in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
 - 2. Provide required vibration isolation and/or seismic controls in accordance with Section 26 05 48.
 - 3. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 - 4. 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.
 - 5. Use conduit strap to support single surface-mounted conduit.
 - a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
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6. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
 7. Use conduit clamp to support single conduit from beam clamp or threaded rod.
 8. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
 9. Use non-penetrating rooftop supports to support conduits routed across rooftops (only where approved).
 10. Use of spring steel conduit clips for support of conduits is not permitted.
 11. Use of wire for support of conduits is not permitted.
 12. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.
- L. 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.
- M. 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. Provide metal escutcheon plates for conduit penetrations exposed to public view.
 10. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- N. Underground Installation:
1. Provide trenching and backfilling in accordance with Section 31 23 16.13.
 2. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Underground, Exterior: 24 inches.
 - b. Under Slab on Grade: 12 inches to bottom of slab.
 3. Provide underground warning tape in accordance with Section 26 05 53 along entire conduit length for service entrance where not concrete-encased.
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- O. Embedment Within Structural Concrete Slabs (only where approved by Structural Engineer):
 - 1. Include proposed conduit arrangement with submittals.
 - 2. Maximum Conduit Size: 1 inch (27 mm) unless otherwise approved.
 - 3. Install conduits within middle one third of slab thickness.
 - 4. Secure conduits to prevent floating or movement during pouring of concrete.
- P. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Section 03 30 00 with minimum concrete cover of 3 inches on all sides unless otherwise indicated.
- Q. Hazardous (Classified) Locations: Where conduits cross boundaries of hazardous (classified) locations, provide sealing fittings located as indicated or in accordance with NFPA 70.
- R. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings or approved flexible connections 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 calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
 - 3. Where calculated in accordance with NFPA 70 for reinforced thermosetting resin conduit (RTRC) conduit installed above ground to compensate for thermal expansion and contraction.
 - 4. Where conduits are subject to earth movement by settlement or frost.
- S. 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.
 - 3. Where conduits penetrate coolers or freezers.
- T. 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 at each end.
- U. Provide grounding and bonding in accordance with Section 26 05 26.
- V. Identify conduits in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 45 16 - Field Quality Control Procedures for City of Madison 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. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.
- D. Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

3.05 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

SECTION 26 05 33.16
BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.
- C. Boxes and enclosures for integrated power, data, and audio/video.
- D. Boxes for hazardous (classified) locations.
- E. Floor boxes.
- F. Underground boxes/enclosures.
- G. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 08 31 00 - Access Doors and Panels: Panels for maintaining access to concealed boxes.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 33.13 - Conduit for Electrical Systems:
 - 1. Conduit bodies and other fittings.
 - 2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
- E. Section 26 05 33.23 - Surface Raceways for Electrical Systems:
- F. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- G. Section 26 27 26 - Wiring Devices:
 - 1. Wall plates.
 - 2. Floor box service fittings.
 - 3. Additional requirements for locating boxes for wiring devices.
- H. Section 27 00 05 - Communications Cabling: Additional requirements for communications systems outlet boxes.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2016.
- C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.
- D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports 2013 (Reaffirmed 2020).
- E. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports 2013 (Reaffirmed 2020).
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- G. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. SCTE 77 - Specifications for Underground Enclosure Integrity 2017.
- 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.
- N. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations Current Edition, Including All Revisions.

1.04 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 of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.
 - 1. Underground Boxes/Enclosures: Include reports for load testing in accordance with SCTE 77 certified by a professional engineer or an independent testing agency upon request.
- C. Samples:
 - 1. Floor Boxes: Provide one sample(s) of each floor box proposed for substitution upon request.
- 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. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Keys for Lockable Enclosures: Two of each different key.

1.06 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. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 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, 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 unless specifically indicated or permitted.
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. Communications Systems Outlets: Comply with Section 27 00 05.
 - c. 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 27 26.
18. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Hubbell Incorporated; Bell Products: www.hubbell-rtb.com/#sle.
 - c. Hubbell Incorporated; RACO Products: www.hubbell-rtb.com/#sle.
 - d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
 - e. Thomas & Betts Corporation: www.tnb.com/#sle.

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- f. Substitutions: See Section 01 60 00 - Product Requirements.
 - C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
 - 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 1, painted steel.
 - b. Outdoor Locations: Type 3R, painted steel.
 - 3. Junction and Pull Boxes Larger Than 100 cubic inches:
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
 - b. Boxes 6 square feet and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
 - 4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
 - a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
 - b. Back Panels: Painted steel, removable.
 - c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.
 - 5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
 - 6. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
 - c. Hubbell Incorporated; Wiegmann Products: www.hubbell-wiegmann.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - D. Boxes and Enclosures for Integrated Power, Data, and Audio/Video: Size and configuration as indicated or as required with partitions to separate services; field-connected gangable boxes may be used.
 - 1. Manufacturers:
 - a. Hubbell Incorporated: www.hubbell.com/#sle.
 - b. Legrand: <https://www.legrand.us/>
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 - E. Boxes for Hazardous (Classified) Locations: Listed and labeled as complying with UL 1203 for the classification of the installed location.
 - 1. Manufacturers:
 - a. Appleton, a brand of Emerson Electric Co: www.emerson.com/#sle.
 - b. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - c. Hubbell Incorporated; Killark Products: www.hubbell-killark.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - F. Floor Boxes:
 - 1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 26 27 26; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
 - 2. Use steel floor box designed for on-grade installations with a fusion-bonded epoxy.
 - 3. Use sheet-steel or cast iron floor boxes within slab above grade.
 - 4. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).
 - 5. Manufacturer: Same as manufacturer of floor box service fittings.
 - G. 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.
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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) Hubbell Incorporated; Quazite Products: www.hubbellpowersystems.com/#sle.
 - 2) MacLean Highline: www.macleanhigline.com/#sle.
 - 3) Oldcastle Precast, Inc: www.oldcastleprecast.com/#sle.
 - 4) Substitutions: See Section 01 60 00 - Product Requirements.
 - b. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.
 - c. Product(s):
 - 1) MacLean Highline PHA Series: Straight wall, all-polymer concrete splice box/pull box; available Tier 8, Tier 15, and Tier 22 load ratings.
 - 2) MacLean Highline CHA Series: Fiberglass/polymer concrete splice box/pull box; available Tier 8 and Tier 15 load ratings.
 - 3) MacLean Highline CVA Series: Fiberglass/polymer concrete splice vault; available Tier 8, Tier 15, and Tier 22 load ratings.

2.02 ACCESSORIES

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for boxes and facade materials to be installed.
 1. Manufacturers:
 - a. Quickflash Weatherproofing Products, Inc: www.quickflashproducts.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) 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 31 00 as required where approved by the Architect.

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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 27 26.
 - b. Communications Systems Outlets: Comply with Section 27 00 05.
 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 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 horizontal separation.
 9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
 - a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
 - b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
 10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 05 33.13.
 11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
 - 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 05 29 using suitable supports and methods approved by the authority having jurisdiction.
 2. Provide required seismic controls in accordance with Section 26 05 48.
 3. 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.
 4. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
 5. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.
 - 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 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 at the edge of the box.
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- L. Floor-Mounted Cabinets: Mount on properly sized 3 inch high concrete pad constructed in accordance with Section 03 30 00.
 - M. Install boxes as required to preserve insulation integrity.
 - N. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.
 - O. Nonmetallic Floor Boxes: Cut box flush with finished floor after concrete pour.
 - P. Underground Boxes/Enclosures:
 - 1. Install enclosure on gravel base, minimum 6 inches deep.
 - 2. Flush-mount enclosures located in concrete or paved areas.
 - 3. Mount enclosures located in landscaped areas with top at 1 inch above finished grade.
 - 4. Provide cast-in-place concrete collar constructed in accordance with Section 03 30 00, minimum 10 inches wide by 12 inches deep, around enclosures that are not located in concrete areas.
 - 5. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.
 - Q. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
 - R. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
 - S. Close unused box openings.
 - T. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
 - U. Provide grounding and bonding in accordance with Section 26 05 26.
 - V. Identify boxes in accordance with Section 26 05 53.

3.03 CLEANING

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.04 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 05 33.23
SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface raceway systems.
- B. Wireways.
- C. Wall duct.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 1. Includes metal channel (strut) used as raceway.
- C. Section 26 05 33.13 - Conduit for Electrical Systems.
- D. Section 26 05 33.16 - Boxes for Electrical Systems.
- E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 27 26 - Wiring Devices: Receptacles.
- G. Section 27 00 05 - Communications Cabling: Voice and data jacks.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- B. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- D. NEMA PRP 5 - Installation Guidelines for Surface Nonmetallic Raceway 2021.
- E. UL 5 - Surface Metal Raceways and Fittings Current Edition, Including All Revisions.
- F. UL 5A - Nonmetallic Surface Raceways and Fittings Current Edition, Including All Revisions.
- G. UL 111 - Outline of Investigation for Multioutlet Assemblies Current Edition, Including All Revisions.
- H. UL 870 - Wireways, Auxiliary Gutters, and Associated Fittings Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of raceways with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate rough-in locations of outlet boxes provided under Section 26 05 33.16 and conduit provided under Section 26 05 33.13 as required for installation of raceways provided under this section.
 - 3. Verify minimum sizes of raceways with the actual conductors and components to be installed.
 - 4. Wall Duct: Coordinate the work with other trades to provide walls suitable for installation of flush-mounted wall duct where indicated.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install raceways until final surface finishes and painting are complete.
 - 2. Do not begin installation of conductors and cables until installation of raceways is complete between outlet, junction and splicing points.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including dimensions, knockout sizes and locations, materials, fabrication details, finishes, service condition requirements, and accessories.
 - 1. Surface Raceway Systems: Include information on fill capacities for conductors and cables.
- C. Shop Drawings:
 - 1. Pre-wired Surface Raceway Systems: Provide plan and elevation views including dimensioned locations of wiring devices and circuiting arrangements.
 - 2. Wireways: Provide dimensioned plan and elevation views including adjacent equipment with all required clearances indicated.
- D. Samples: Three of each type and color of surface raceway system specified, 6 inches in length.
- E. Manufacturer's 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.

1.06 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. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS**2.01 RACEWAY REQUIREMENTS**

- A. Provide all components, fittings, supports, and accessories required for a complete raceway system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Do not use raceways for applications other than as permitted by NFPA 70 and product listing.

2.02 SURFACE RACEWAY SYSTEMS

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com/#sle.
 - 2. MonoSystems, Inc: www.monosystems.com/#sle.
 - 3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Surface Metal Raceways: Listed and labeled as complying with UL 5.
- C. Surface Nonmetallic Raceways: Listed and labeled as complying with UL 5A.
- D. Multioutlet Assemblies: Listed and labeled as complying with UL 111.
- E. Metal Channel (Strut) Used as Raceway: Comply with Section 26 05 29.

2.03 WIREWAYS

- A. Manufacturers:
 - 1. Cooper B-Line, a division of Cooper Industries: www.cooperindustries.com/#sle.
 - 2. Enduro Composites: www.endurocomposites.com/#sle.

3. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
 4. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: Lay-in wireways and wiring troughs with removable covers; listed and labeled as complying with UL 870.
- C. Wireway Type, Unless Otherwise Indicated:
1. Indoor Clean, Dry Locations: NEMA 250, Type 1, painted steel with screw-cover.
 2. Outdoor Locations: NEMA 250, Type 3R, painted steel with screw-cover; include provision for padlocking.
- D. Finish for Painted Steel Wireways: Manufacturer's standard grey unless otherwise indicated.
- E. Minimum Wireway Size: 4 by 4 inches unless otherwise indicated.
- F. Where wireway size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.04 WALL DUCT

- A. Manufacturers:
1. Dennis Filges Company, Inc: www.filgesco.com/#sle.
 2. Hubbell Incorporated: www.hubbell.com/#sle.
 3. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
 4. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.
 5. Substitutions: See Section 01 60 00 - Product Requirements.
 6. Source Limitations: Where the wall duct system includes connections to trench duct, furnish wall duct and associated components produced by the same manufacturer as the trench duct to be installed.
- B. Description: Metal raceways specifically designed for enclosure of wiring to X-ray machines and similar medical equipment; listed and labeled as complying with UL 870.
- C. Material: Steel, unless otherwise indicated.
- D. Mounting Provisions: Suitable for surface- or flush-mounting as indicated.
- E. Size: As indicated on the drawings.

2.05 SOURCE QUALITY CONTROL

- A. See Section 01 45 16 - Field Quality Control Procedures for City of Madison additional requirements.
- B. Factory test each production unit for pre-wired surface raceway systems to verify proper wiring.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes and conduit terminations are installed in proper locations and are properly sized in accordance with NFPA 70 to accommodate raceways.
- C. Verify that mounting surfaces are ready to receive raceways and that final surface finishes are complete, including painting.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Surface Nonmetallic Raceways: Install in accordance with NEMA PRP 5.
- D. Install raceways plumb and level.

- E. Arrange wireways and associated raceway connections to comply with NFPA 70, including but not limited to requirements for deflected conductors and wireways used as pullboxes. Increase size of wireway where necessary.
- F. Secure and support raceways in accordance with Section 26 05 29 at intervals complying with NFPA 70 and manufacturer's requirements.
- G. Close unused raceway openings.
- H. Provide grounding and bonding in accordance with Section 26 05 26.
- I. Identify raceways in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 45 16 - Field Quality Control Procedures for City of Madison additional requirements.
- B. Inspect raceways for damage and defects.
- C. Surface Raceway Systems with Integrated Devices: Test each wiring device to verify operation and proper polarity.
- D. Correct wiring deficiencies and replace damaged or defective raceways.

3.04 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 PROTECTION

- A. Protect installed raceways from subsequent construction operations.

END OF SECTION

SECTION 26 05 36
CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal cable tray systems:
 - 1. Metal ladder cable tray.
 - 2. Metal wire mesh/basket cable tray.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
- C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- D. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 27 00 05 - Communications Cabling.

1.03 REFERENCE STANDARDS

- A. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2023.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- C. NEMA VE 1 - Metal Cable Tray Systems 2017.
- D. NEMA VE 2 - Cable Tray Installation Guidelines 2018.
- E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the arrangement of cable tray with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others. Coordinate the work with other trades to avoid installation of obstructions within cable tray required clearances.
 - 2. Coordinate arrangement of cable tray with the dimensions and clearance requirements of the actual products to be installed.
 - 3. Coordinate the work with placement of supports, anchors, etc. required for mounting.
 - 4. Notify of any conflicts with or deviations from 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. Review proposed routing, sequence of installation, and protection requirements for installed cable tray.
- C. Sequencing:
 - 1. Do not begin installation of cables until installation of associated cable tray run is complete.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cable tray system components and accessories. Include dimensions, materials, fabrication details, finishes, and span/load ratings.
- C. Shop Drawings: Include dimensioned plan views and sections indicating proposed cable tray routing, required clearances, and locations and details of supports, fittings, building element penetrations, and equipment connections.

- D. Manufacturer's 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. Project Record Documents: Record actual routing of cable tray and locations of supports.

1.06 QUALITY ASSURANCE

- A. Comply with 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.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions and NEMA VE 2, except do not store cable tray outdoors without cover as permitted in NEMA VE 2.
- B. Handle products carefully to avoid damage to finish.

PART 2 PRODUCTS

2.01 CABLE TRAY SYSTEM - GENERAL REQUIREMENTS

- A. Provide new cable tray system consisting of all required components, fittings, supports, accessories, etc. as necessary for a complete system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Do not use cable tray for applications other than as permitted by NFPA 70 and product listing/classification.
- D. Provide cable tray system and associated components suitable for use at indicated span/load ratings under the service conditions at the installed location.
- E. Unless otherwise indicated, specified span/load ratings are based on safety factor of 1.5 and working load only (no additional concentrated static load), with ratings for metal cable tray systems in accordance with NEMA VE 1.
- F. Unless otherwise indicated, specified load/fill depths and inside widths are nominal values, with values for metal cable tray systems in accordance with NEMA VE 1 including applicable allowable tolerances.

2.02 METAL CABLE TRAY SYSTEMS

- A. Manufacturers:
 - 1. Metal Cable Tray System:
 - a. Cablofil, a brand of Legrand North America, Inc: www.legrand.us/#sle.
 - b. Chalfant Manufacturing Company: www.chalfant-obo.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
 - 3. Source Limitations: Furnish cable tray system and associated components and accessories produced by a single manufacturer and obtained from a single supplier.
- B. Comply with NEMA VE 1.
- C. Finishes:
 - 1. Zinc Electroplated Steel: Comply with ASTM B633.
 - 2. Mill-Galvanized Before Fabrication (Pre-Galvanized) Steel: Comply with ASTM A653/A653M, G90 coating.
- D. Metal Ladder Cable Tray:
 - 1. Material: Mill-galvanized before fabrication (pre-galvanized) steel.

2. Side Rail Construction: I-beam, C-channel flange out, or C-channel flange in.
 3. Load/Fill Depth: As indicated on drawings.
 4. Span/Load Rating: As indicated on drawings.
 5. Rung Spacing: 9 inches on center for straight lengths.
 6. Inside Width: As indicated on drawings.
 7. Inside Radius of Fittings: 12 inches.
- E. Metal Wire Mesh/Basket Cable Tray:
1. Material: Zinc electroplated steel or mill-galvanized before fabrication (pre-galvanized) steel.
 2. Tray Depth: As indicated on drawings.
 3. Span/Load Rating: As indicated on drawings.
 4. Mesh Spacing: 2 by 4 inches.
 5. Tray Width: As indicated on drawings.
 6. Products:
 - a. Chalfant Manufacturing GR-Magic: www.chalfant-obo.com/#sle.
 - b. Hubbell Incorporated: www.hubbell.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 SOURCE QUALITY CONTROL

- A. See Section 01 45 16 - Field Quality Control Procedures for City of Madison additional requirements.
- B. Metal Cable Tray: Perform factory design tests in accordance with NEMA VE 1, including electrical continuity and load testing.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that work likely to damage cable tray system has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that the dimensions and span/load ratings of cable tray system components are consistent with the indicated requirements.
- D. Verify that mounting surfaces are ready to receive cable tray and associated supports.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install cable tray in accordance with NECA 1 (general workmanship), and NEMA VE 2.
- C. Unless otherwise indicated, arrange cable tray to be parallel or perpendicular to building lines.
- D. Arrange cable tray to provide required clearances and maintain cable access.
- E. Install cable tray plumb and level, with sections aligned and with horizontal runs at the proper elevation.
- F. Metal Wire Mesh/Basket Cable Tray: Field fabricate fittings in accordance with manufacturer's instructions, using only manufacturer-approved connectors classified for bonding.
 1. Inside Radius of Fittings: 12 inches.
- G. Cable Tray Movement Provisions:
 1. Provide suitable expansion fittings where cable tray is subject to movement, including but not limited to:
 - a. Where cable tray crosses structural joints intended for expansion.
 - b. Long straight cable tray runs in accordance with NEMA VE 2.
 2. Use expansion guides in lieu of hold-down clamps where prescribed in NEMA VE 2.
 3. Set gaps for expansion fittings in accordance with NEMA VE 2.

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- H. Cable Provisions:
 - 1. Use suitable fixed barrier strips to maintain separation of cables as indicated and as required by NFPA 70.
 - 2. Use suitable drop-out fittings or bushings where cables exit cable tray as required to maintain minimum cable bending radius.
 - 3. Use suitable cable support fittings for long vertical cable tray runs with heavy cables.
 - I. Provide end closures at unconnected ends of cable tray runs.
 - J. Cable Tray Support:
 - 1. Use manufacturer's recommended hangers and supports, located in accordance with NEMA VE 2 and manufacturer's requirements, but not exceeding specified span unless otherwise approved by Engineer. Provide required support and attachment in accordance with Section 26 05 29, where not furnished by cable tray manufacturer.
 - 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 - K. Grounding and Bonding Requirements, in Addition to Requirements of Section 26 05 26:
 - 1. Comply with grounding and bonding requirements of NEMA VE 2.
 - 2. Metal Cable Tray Systems: Use suitable bonding jumpers or classified connectors to provide electrical continuity.
 - 3. Provide suitable equipment grounding conductor in each cable tray, except where cable tray contains only multiconductor cables with integral equipment grounding conductors. Do not use metal cable tray system as sole equipment grounding conductor.
 - a. Equipment Grounding Conductor for Steel Cable Tray: Use bare or insulated copper conductor.
 - b. Equipment Grounding Conductor for Aluminum Cable Tray: Use insulated copper conductor only; do not use bare copper conductor.
 - c. Minimum Equipment Grounding Conductor Size: 6 AWG copper.
 - d. Bond equipment grounding conductor to each cable tray section using suitable listed ground clamps. Separate bonding jumpers are not required where properly bonded equipment grounding conductor provides equivalent continuity.
 - L. Conduit Termination:
 - 1. Use listed cable tray conduit clamps (evaluated for bonding connection) to terminate conduits at cable tray.
 - 2. Provide insulating bushing at conduit termination to protect cables.
 - 3. Provide independent support for conduit.
 - M. Cable Installation:
 - 1. Comply with cable installation requirements of NEMA VE 2.
 - 2. Use appropriate cable pulling tools, applied to prevent excessive force on cable tray system and maintain minimum cable bending radius.
 - 3. Use cable clamps or cable ties to fasten conductors/cables to vertical and horizontal runs of cable tray.
 - a. Distance Between Fastening Points for Vertical Runs: 18 inches.
 - b. Distance Between Fastening Points for Horizontal Runs: As required to maintain spacing and confine conductor/cable within the cable fill area.
 - N. Penetrations: Install firestopping to preserve fire resistance rating of building elements, using materials and methods specified in Section 07 84 00.
 - O. Identification Requirements, in Addition to Those Specified in Section 26 05 53.
 - P. Install cable tray covers where indicated and as follows:

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.

- B. Inspect cable tray system for damage and defects.
- C. Correct deficiencies and replace damaged or defective cable tray system components.

3.04 ADJUSTING

- A. Adjust tightness of mechanical connections to manufacturer's recommended torque settings.

3.05 CLEANING

- A. Remove dirt and debris from cable tray.
- B. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.06 PROTECTION

- A. Protect cable tray system from subsequent construction operations.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Underground warning tape.
- F. Floor marking tape.
- G. Warning signs and labels.

1.02 RELATED REQUIREMENTS

- A. Section 09 91 13 - Exterior Painting.
- B. Section 09 91 23 - Interior Painting.
- C. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- D. Section 26 05 73.10 - Power System Studies: Arc flash hazard warning labels.
- E. Section 26 27 26 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.
- F. Section 26 31 00 - Photovoltaic Collectors: Additional identification requirements for photovoltaic systems.
- G. Section 27 00 05 - Communications Cabling: Identification for communications cabling and devices.

1.03 REFERENCE STANDARDS

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs 2011 (Reaffirmed 2017).
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels 2011 (Reaffirmed 2017).
- 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 2024.
- E. UL 969 - Marking and Labeling Systems Current Edition, Including All Revisions.

1.04 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.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

- C. Samples:
 - 1. Identification Nameplates: One of each type and color specified.
 - 2. Warning Signs and Labels: One of each type and legend specified.
- D. Manufacturer's 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.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.07 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01 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. Switchboards:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Use identification nameplate to identify main overcurrent protective device.
 - 5) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
 - b. Panelboards:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 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.
 - 6) For power panelboards without a door, use typewritten circuit directory to identify load(s) served for each branch device. Identify spares and spaces.
 - c. Enclosed switches, circuit breakers, and motor controllers:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location when not within sight of equipment.
 - 3) Identify load(s) served. Include location when not within sight of equipment.
 - d. Busway:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Provide identification at maximum intervals of 40 feet.

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- 5) Use identification nameplate to identify load(s) served for each plug-in unit. Include location when not within sight of equipment.
 - e. Time Switches:
 - 1) Identify load(s) served and associated circuits controlled. Include location.
 - f. 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 E.O.M.H. (electrically operated, mechanically held).
 - 4) Identify coil voltage.
 - 5) Identify load(s) and associated circuits controlled. Include location.
 - g. Centralized Emergency Lighting Inverters:
 - 1) Identify input and output voltage and phase.
 - 2) Identify power source and circuit number for normal power source. Include location when not within sight of equipment.
 - 3) Identify load(s) served. Include location.
 - h. Transfer Switches:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number for both normal power source and standby power source. Include location when not within sight of equipment.
 - 3) Identify load(s) served. Include location when not within sight of equipment.
 - 4) Identify short circuit current rating based on the specific overcurrent protective device type and settings protecting the transfer switch.
 - i. Electricity Meters:
 - 1) Identify load(s) metered.
 2. Service Equipment:
 - a. Use identification nameplate to identify each service disconnecting means.
 - b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
 3. Emergency System Equipment:
 - a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
 - b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.
 - c. Use identification nameplate to identify emergency operating instructions for emergency system equipment.
 4. Use voltage marker to identify highest voltage present for each piece of electrical equipment.
 5. Use identification nameplate to identify equipment utilizing series ratings, where permitted, in accordance with NFPA 70.
 6. Use identification nameplate to identify switchboards and panelboards utilizing a high leg delta system in accordance with NFPA 70.
 7. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
 8. Use identification nameplate on inside of door at each fused switch to identify required NEMA fuse class and size.
 9. Use identification nameplate on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.
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10. Use identification nameplate to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
 11. Use field-painted floor markings, floor marking tape, or warning labels to identify required equipment working clearances where indicated or where required by the authority having jurisdiction.
 - a. Field-Painted Floor Markings: Alternating black and white stripes, 3 inches wide, painted in accordance with Section 09 91 23 and 09 91 13.
 12. 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.
 - b. Industrial control panels.
 - c. Motor control centers.
 - d. Elevator control panels.
 - e. Industrial machinery.
 13. Arc Flash Hazard Warning Labels: Comply with Section 26 05 73.10.
 14. 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.
 15. Use warning signs to identify electrical hazards for entrances to all buildings, vaults, rooms, or enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
 16. 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".
 17. 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: Comply with Section 26 05 19.
 2. Identification for Communications Conductors and Cables: Comply with Section 27 00 05.
 3. Use identification nameplate 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.
 4. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
 - a. At each source and load connection.
 - b. Within boxes when more than one circuit is present.
 - c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
 - d. In cable tray, at maximum intervals of 20 feet.
 5. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
 6. Use underground warning tape to identify direct buried cables.
- D. Identification for Raceways:
1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet.
 2. Use voltage markers or color-coded bands to identify systems other than normal power system for accessible conduits at maximum intervals of 20 feet.
 - a. Color-Coded Bands: Use field-painting or vinyl color coding electrical tape to mark bands 3 inches wide.
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- 1) Color Code:
 - (a) Emergency Power System: Red.
 - (b) Fire Alarm System: Red.
 - 2) Field-Painting: Comply with Section 09 91 23 and 09 91 13.
 - 3) Vinyl Color Coding Electrical Tape: Comply with Section 26 05 19.
3. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.
 4. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
 5. Use underground warning tape to identify underground raceways.
 6. Use voltage markers to identify highest voltage present for wireways at maximum intervals of 20 feet.
- E. Identification for Cable Tray: Comply with Section 26 05 36.
- F. Identification for Boxes:
1. Use voltage markers to identify highest voltage present.
 2. Use voltage markers or color coded boxes to identify systems other than normal power system.
 - a. Color-Coded Boxes: Field-painted in accordance with Section 09 91 23 and 09 91 13 per the same color code used for raceways.
 - 1) Fire Alarm System: Red.
 - b. For exposed boxes in public areas, do not color code.
 3. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
 - a. For exposed boxes in public areas, use only identification labels.
 4. Use warning labels to identify electrical hazards for boxes containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
- G. Identification for Devices:
1. Identification for Communications Devices: Comply with Section 27 00 05.
 2. Wiring Device and Wallplate Finishes: Comply with Section 26 27 26.
 3. Factory Pre-Marked Wallplates: Comply with Section 26 27 26.
 4. Use identification label to identify fire alarm system devices.
 - a. For devices concealed above suspended ceilings, provide additional identification on ceiling tile below device location.
 5. 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.
 6. 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.
 7. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.
- H. Identification for Luminaires:
1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.
- I. Identification for Photovoltaic Systems: Comply with Section 26 31 00

2.02 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
1. Manufacturers:
 - a. Brimar Industries, Inc: www.brimar.com/#sle.
 - b. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
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- c. Seton Identification Products: www.seton.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - 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 non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
 - a. Exception: Provide minimum thickness of 1/8 inch when any dimension is greater than 4 inches.
 - 4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
 - 5. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
 - 6. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
- B. Identification Labels:
- 1. Manufacturers:
 - a. Brady Corporation: www.bradyid.com/#sle.
 - b. Brother International Corporation: www.brother-usa.com/#sle.
 - c. Panduit Corp: www.panduit.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 - a. Use only for indoor locations.
 - 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 by 2.5 inches.
 - 2. Legend:
 - a. System designation where applicable:
 - 1) Emergency Power System: Identify with text "EMERGENCY".
 - 2) Fire Alarm System: Identify with text "FIRE ALARM".
 - b. Equipment designation or other approved description.
 - c. Other information as indicated.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height:
 - a. System Designation: 1 inch.
 - b. Equipment Designation: 1/2 inch.
 - c. Other Information: 1/4 inch.
 - d. Exception: Provide minimum text height of 1 inch for equipment located more than 10 feet above floor or working platform.
 - 5. Color:
 - a. Normal Power System: White text on black background.
 - b. Emergency Power System: White text on red background.
 - c. Fire Alarm System: White text on red background.
- D. Format for General Information and Operating Instructions:
- 1. Minimum Size: 1 inch by 2.5 inches.
 - 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height: 1/4 inch.
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5. Color: Black text on white background unless otherwise indicated.
 - a. Exceptions:
 - 1) Provide white text on red background for general information or operational instructions for emergency systems.
 - 2) Provide white text on red background for general information or operational instructions for fire alarm systems.
 - E. Format for Caution and Warning Messages:
 1. Minimum Size: 2 inches by 4 inches.
 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 1/2 inch.
 5. Color: Black text on yellow background unless otherwise indicated.
 - F. Format for Receptacle Identification:
 1. Minimum Size: 3/8 inch by 1.5 inches.
 2. Legend: Power source and circuit number or other designation indicated.
 - a. Include voltage and phase for other than 120 V, single phase circuits.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 3/16 inch.
 5. Color: Black text on clear background.
 - G. Format for Control Device Identification:
 1. Minimum Size: 3/8 inch by 1.5 inches.
 2. Legend: Load controlled or other designation indicated.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 3/16 inch.
 5. Color: Black text on clear background.
 - H. Format for Fire Alarm Device Identification:
 1. Minimum Size: 3/8 inch by 1.5 inches.
 2. Legend: Designation indicated and device zone or address.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 3/16 inch.
 5. Color: Red text on white background.

2.03 WIRE AND CABLE MARKERS

- A. Manufacturers:
 1. Brady Corporation: www.bradyid.com/#sle.
 2. HellermannTyton: www.hellermannntyton.com/#sle.
 3. Panduit Corp: www.panduit.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
 - 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.
 - G. Color: Black text on white background unless otherwise indicated.
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2.04 VOLTAGE MARKERS

- A. Manufacturers:
 - 1. Brady Corporation: www.bradyid.com/#sle.
 - 2. Brimar Industries, Inc: www.brimar.com/#sle.
 - 3. Seton Identification Products: www.seton.com/#sle.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- 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 Equipment: 1 1/8 by 4 1/2 inches.
 - 2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
 - 3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
 - 4. Markers for Junction Boxes: 1/2 by 2 1/4 inches.
- E. Legend:
 - 1. Markers for Voltage Identification: Highest voltage present.
 - 2. Markers for System Identification:
 - a. Emergency Power System: Text "EMERGENCY".
 - b. Other Systems: Type of service.
- F. Color: Black text on orange background unless otherwise indicated.

2.05 UNDERGROUND WARNING TAPE

- A. Manufacturers:
 - 1. Brady Corporation: www.bradyid.com/#sle.
 - 2. Brimar Industries, Inc: www.brimar.com/#sle.
 - 3. Seton Identification Products: www.seton.com/#sle.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
 - 1. Exception: Use foil-backed detectable type tape where required by serving utility or where directed by Owner.
- C. Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil.
- D. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.
- E. Legend: Type of service, continuously repeated over full length of tape.
- F. Color:
 - 1. Tape for Buried Power Lines: Black text on red background.
 - 2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.06 FLOOR MARKING TAPE

- A. Manufacturers:
 - 1. Brady Corporation: www.bradyid.com/#sle.
 - 2. Brimar Industries, Inc: www.brimar.com/#sle.
 - 3. Insite Solutions, LLC: www.stop-painting.com/#sle.
 - 4. Seton Identification Products: www.seton.com/#sle.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.

- B. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlamine, 3 inches wide, with alternating black and white stripes.

2.07 WARNING SIGNS AND LABELS

- A. Manufacturers:
 - 1. Brimar Industries, Inc: www.brimar.com/#sle.
 - 2. Clarion Safety Systems, LLC: www.clarionsafety.com/#sle.
 - 3. Insite Solutions, LLC: www.stop-painting.com/#sle.
 - 4. Seton Identification Products: www.seton.com/#sle.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- 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 unless otherwise indicated.
- D. Warning Labels:
 - 1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
 - a. Do not use labels designed to be completed using handwritten text.
 - b. 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 unless otherwise indicated.
- E. Floor Signs:
 - 1. Materials: Use factory preprinted, self-adhesive vinyl, polyester, or rubber labels with protective overlamine; removable.
 - 2. Minimum Size: 17-inch diameter unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 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 below finished grade.
- G. Secure rigid signs using stainless steel screws.
- H. Mark all handwritten text, where permitted, to be neat and legible.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 45 16 - Field Quality Control Procedures for City of Madison 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 05 73.10
POWER SYSTEM STUDIES - SCHNEIDER ELECTRIC

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

1.02 ABBREVIATIONS AND ACRONYMS

- A. PSSS: Power system study supplier.
- B. TCC: Time-current curves.
- C. DER: Distributed energy resources.

1.03 REFERENCE STANDARDS

- A. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels 2011 (Reaffirmed 2017).
- B. ISO 9001 - Quality Management Systems — Requirements 2015.
- 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 2024.
- E. UL 969 - Marking and Labeling Systems Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate work with power system study supplier to provide complete, accurate studies and associated application of study results to equipment and systems.
 - 2. Coordinate with Owner to gather input data required for power system studies.
- B. Sequencing:
 - 1. Submit initial studies prior to receiving release to furnish electrical distribution equipment.
 - 2. After sufficient data is available to ensure proper selection of devices, submit completed studies.
 - 3. If completion of studies may cause delays in equipment shipments, request exception for preliminary submittal of data to ensure selection of device ratings and characteristics are satisfactory to properly select distribution equipment.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Application software including modules or software plug-ins used to perform studies.
- C. Power System Study Reports:
 - 1. Summarize results of studies in final report signed and sealed by registered professional engineer.
 - 2. In addition to hardcopies required by Contract Documents, provide electronic PDF files of report on digital media acceptable to Owner.
 - 3. Report Contents:
 - a. Executive summary including introduction, scope of work, results, and recommendations.
 - b. Power System One-Line Diagram: Computer generated; identify individual equipment buses and cable/bus connections between equipment.
 - c. Identify calculation methods, missing/incomplete data, and assumptions with justifications.
 - d. Short-Circuit Analysis:
 - 1) Short-circuit methodology, analysis, results, and recommendations.
 - 2) Short-circuit device evaluation table.
 - 3) Identify bus number used in short-circuit analysis and calculated maximum short-circuit current at each bus location on power system one-line diagram.

- e. Protective Device Time-Current Coordination Analysis:
 - 1) Protective device coordination methodology, analysis, results, and recommendations.
 - 2) Protective device settings table.
 - 3) Time-current coordination graphs and recommendations.
 - 4) Identify device numbers used in time-current coordination on power system one-line diagram.

1.06 QUALITY ASSURANCE

- A. Electrical Power System Software for Studies: Developed under established quality assurance program certified in accordance with ISO 9001 and regularly reviewed and audited by third-party registrar.
- B. Power System Study Supplier (PSSS) Qualifications:
 - 1. Minimum 25 years of experience in performing power system studies.
 - 2. Conduct studies under responsible charge and approval of registered professional engineer with minimum of five years of experience in performing and interpreting electrical power system studies.

PART 2 PRODUCTS

2.01 POWER SYSTEM STUDY SUPPLIERS (PSSS)

- A. Schneider Electric Engineering Services; www.se.com/#sle.
- B. Source Limitations: Provide power system studies by same supplier as electrical distribution equipment for project.

2.02 POWER SYSTEM STUDIES

- A. Software for Study Preparation: Perform power system studies using robust electrical power system design and analysis software package; manual calculations are not acceptable.
 - 1. Products:
 - a. ETAP by Operation Technology, Inc: www.etap.com/#sle.
- B. Data:
 - 1. Gather input data required for power system studies, including existing equipment and equipment furnished by others.
 - 2. PSSS to furnish list of required data to Contractor immediately after award of contract; Contractor to expedite collection of data to assure completion of studies as required for final approval of distribution equipment shop drawings and prior to release of equipment for manufacturing.
 - 3. Source Combination: Include current and identified future motors, generators, and DER systems.
 - 4. Load Data: Include existing and proposed loads obtained from Contract Documents or provided by Engineer.
- C. Short-Circuit Analysis:
 - 1. Identify selected base per unit quantities.
 - 2. Provide one-line diagram that identifies individual equipment buses, bus numbers, and cable/bus connections between equipment.
 - 3. Identify input circuit data pertinent to calculations including electric utility system characteristics, source impedance data, conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, and motor contributions.
 - 4. Provide tabulations of calculated quantities including short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings, and notes regarding adequacy or inadequacy of equipment rating.

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5. Summarize results, conclusions, and recommendations including discussion section evaluating adequacy or inadequacy of equipment with recommendations for improvements to system.
 6. Use transformer design impedances when test impedances are not available.
 7. For solidly grounded systems, provide bolted line-to-ground fault current study for applicable buses as determined by engineer performing study.
 8. Protective Device Evaluation:
 - a. Include evaluation of equipment and protective devices with comparison to short-circuit ratings.
 - b. Include evaluation of adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses.
 - c. PSSS to notify Engineer in writing of circuit protective devices improperly rated for calculated available fault current.
- D. Protective Device Time-Current Coordination Analysis:
1. Display protective device coordination time-current curves (TCC) on log-log scale graphs.
 2. Provide complete title with descriptive device names on each TCC graph.
 3. Provide device termination characteristic curves at point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
 4. Identify device associated with each curve by manufacturer type, function, and, where applicable, recommended tap, time delay, and instantaneous settings.
 5. Plot the following characteristics on TCC graphs where applicable:
 - a. Electric utility's overcurrent protective device.
 - b. Medium-voltage equipment overcurrent relays.
 - c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 - d. Low-voltage equipment circuit breaker trip devices including manufacturer's tolerance bands.
 - e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
 - f. Medium-voltage conductor damage curves.
 - g. Ground fault protective devices.
 - h. Pertinent motor starting characteristics and motor damage points.
 - i. Pertinent generator short-circuit decrement curve and generator damage point.
 - j. Largest feeder circuit breaker in each motor control center and panelboard.
 6. Provide adequate time margins between device characteristics for selective operation while providing proper protection.
 7. Provide one-line diagram that identifies individual equipment buses, bus numbers, device identification numbers, and maximum available short-circuit current at each bus where known.
 8. Provide enough log-log plots to indicate degree of system protection and coordination by displaying time-current characteristics of series-connected overcurrent devices.
 9. Provide computer printouts that accompany log-log plots with descriptions for each device shown, settings of adjustable devices, and device identification numbers for locating devices on log-log plots and system one-line diagram.
 10. Provide separate, tabular printout with recommended settings of adjustable overcurrent protective devices, equipment designation where device is located, and device number corresponding to device on system one-line diagram.
 11. Summarize results, conclusions, and recommendations including discussion section that evaluates degree of system protection and service continuity with overcurrent devices, with recommendations for addressing system protection or device coordination deficiencies.
 12. PSSS to notify Engineer in writing of significant deficiencies in protection and/or coordination and provide recommendations for improvements.
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2.03 ARC FLASH LABELS

- A. Arc flash labels to be provided by Contractor for equipment identified in study and respective equipment access areas.
 - 1. Floor-Standing Equipment:
 - a. Provide labels on front of each individual section.
 - b. For equipment requiring rear and/or side access, provide labels on each individual section access area.
 - c. Label equipment line-ups containing sections with multiple incident energy and flash protection boundaries as identified in arc flash analysis table.
 - 2. Wall-Mounted Equipment: Provide labels on front cover or nearby adjacent surface, depending upon equipment configuration.
 - 3. General-Use Safety Labels: Provide on equipment in coordination with arc flash labels to warn of general electrical hazards associated with shock, arc flash, and explosions, and instruct workers to turn off power prior to work.
- B. Labels: 4-inch by 4-inch thermal transfer type of high adhesion polyester.
- C. Comply with ANSI Z535.4 and NFPA 70; listed as complying with UL 969.
- D. Include the following information:
 - 1. System voltage.
 - 2. Flash protection boundary.
 - 3. Arc flash incident energy value (cal/sq cm).
 - 4. Limited and restricted approach boundaries.
 - 5. Study report number and issue date.
- E. Print labels using thermal transfer printer, with no field markings.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Arc flash labels to be field installed by power system study supplier.

3.02 FIELD QUALITY CONTROL

- A. See Section 01 45 16 - Field Quality Control Procedures for City of Madison additional requirements.
- B. Contractor to provide services of qualified field technician to adjust parameters of existing equipment as agreed upon by Engineer and Owner and report to Engineer discrepancies or issues with adjustments.

3.03 CLOSEOUT ACTIVITIES

- A. See Section 01 77 00 - Closeout Submittals for City of Madison additional submittals.
- B. See Section 01 79 00 - Demonstration and Training for City of Madison additional requirements.
- C. Arc Flash Training: Power system study supplier to train Owner's personnel on potential arc flash hazards associated with working on energized equipment.
 - 1. Provide not less than four hours of training.
 - 2. Provide instructor-led, online NFPA 70E training classes.
 - 3. Provide training certified for continuing education units (CEUs) by International Association for Continuing Education Training (IACET) or equivalent.
 - 4. Instructor: Authorized by OSHA Outreach.

END OF SECTION

**SECTION 26 05 83
WIRING CONNECTIONS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 26 05 33.13 - Conduit for Electrical Systems.
- C. Section 26 05 33.16 - Boxes for Electrical Systems.
- D. Section 26 27 26 - Wiring Devices.

1.03 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices 1999 (Reaffirmed 2020).
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications 2021.
- C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
 - 2. Determine connection locations and requirements.
- B. Sequencing:
 - 1. Install rough-in of electrical connections before installation of equipment is required.
 - 2. Make electrical connections before required start-up of equipment.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
- C. Manufacturer's 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.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.
- 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**2.01 MATERIALS**

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
 - 1. Colors: Comply with 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 28 16.16 and in individual equipment sections.
- C. Wiring Devices: As specified in Section 26 27 26.
- D. Flexible Conduit: As specified in Section 26 05 33.13.
- E. Wire and Cable: As specified in Section 26 05 19.
- F. Boxes: As specified in Section 26 05 33.16.

2.02 EQUIPMENT CONNECTIONS

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 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.
- J. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

END OF SECTION

SECTION 26 09 13.13
ELECTRICAL POWER MANAGEMENT SYSTEM - SCHNEIDER ELECTRIC SQUARE D ECOSTRUXURE
PME

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

- A. Section 26 24 16.11 - Panelboards - Schneider Electric Square D NQ / NF.
- B. Section 26 24 16.23 - Panelboards - Schneider Electric Square D I-line / QMB.
- C. Section 26 27 13.13 - Power and Energy Meters - Schneider Electric PowerLogic.
- D. Section 26 27 13.16 - Power Quality Meters - Schneider Electric PowerLogic.

1.02 ABBREVIATIONS AND ACRONYMS

- A. PQ: Power quality.
- B. PTP: Precision time protocol.

1.03 DEFINITIONS

- A. Electrical power management system may also be identified as EPMS, EMS, PEMS, energy management system, electrical power monitoring system, power and energy monitoring system, or energy and power management system.
- B. Precision Time Protocol: Protocol for accurate and precise network synchronization of clocks, complying with IEEE 1588.

1.04 REFERENCE STANDARDS

- A. IEC 62443-2-1 - Industrial Communication Networks – Network and System Security – Part 2-1: Establishing an Industrial Automation and Control System Security Program 2010.
- B. IEC 62443-2-4 - Security for Industrial Automation and Control Systems – Part 2-4: Security Program Requirements for IACS Service Providers 2015, with Amendment (2017).
- C. IEC 62443-3-3 - Industrial Communication Networks – Network and System Security – Part 3-3: System Security Requirements and Security Levels 2013 (Corrigendum 2014).
- D. IEC 62443-4-1 - Security for Industrial Automation and Control Systems – Part 4-1: Secure Product Development Lifecycle Requirements 2018.
- E. IEC 62443-4-2 - Security for Industrial Automation and Control Systems – Part 4-2: Technical Security Requirements for IACS Components 2019.
- F. IEC TR 62443-2-3 - Security for Industrial Automation and Control Systems – Part 2-3: Patch Management in the IACS Environment 2015.
- G. IEC TR 62443-3-1 - Industrial Communication Networks – Network and System Security – Part 3-1: Security Technologies for Industrial Automation and Control Systems 2009.
- H. IEC TS 62443-1-1 - Industrial Communication Networks – Network and System Security – Part 1-1: Terminology, Concepts, and Models 2009.
- I. IEEE 1588 - IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems 2019.
- J. ISO 9001 - Quality Management Systems — Requirements 2015.
- K. ISO 50001 - Energy Management Systems – Requirements with Guidance for Use 2018.
- L. ISO 50002 - Energy Audits – Requirements with Guidance for Use 2014.
- M. ISO 50006 - Energy Management Systems – Measuring Energy Performance Using Energy Baselines (EnB) and Energy Performance Indicators (EnPI) – General Principles and Guidance 2014.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate work to provide EPMS-compatible equipment and systems with sensors, interfaces, and other appurtenances required for specified functionality.
- B. Software Configuration Review Meetings:
 - 1. Review proposed screens and report formats with Owner and Engineer throughout configuration process.
 - 2. Convene minimum of two meetings at Owner's facilities, one for initial review and one at approximately 50 percent completion. EPMS supplier's programming personnel to attend initial review meeting.

1.06 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Software Configuration Standards and Conventions:
 - 1. EPMS supplier to document decisions made during first EPMS software configuration review meeting.
 - 2. Provide color documents for accuracy, using accurately depicted colors and shapes proposed for use in final system; black and white documents are not acceptable.
 - 3. Include the following for review and approval before software configuration commences:
- C. Shop Drawings:
 - 1. Provide elementary and interconnection diagrams for field-monitoring devices and networking components, including power, signal, control, and communications wiring with network addresses.
 - 2. Identify network connections, protocols, device room locations, and recommended installation notations.
 - 3. EPMS-Connected LV Switchgear: Provide project-specific drawings for each switchgear/breaker.
- D. Commissioning Report: Provide detailed scope of work checklist document with delivered functionality listed and checked.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Firm engaged in manufacture of specified products of types and sizes required, and whose products have been in satisfactory use in similar service for minimum of 10 years.
 - 2. Certified in accordance with ISO 9001 with applicable quality assurance system regularly reviewed and audited by third-party registrar. Develop and control manufacturing, inspection, and testing procedures under guidelines of quality assurance system.
 - 3. Service, repair, and technical support services available 24 hours per day, 7 days per week from manufacturer or their representative.
- B. Design Tests:
 - 1. Test EPMS in test-bed environment with hardware devices representative of large-scale functional power distribution system, including both physical and simulated devices, such as advanced power quality meters, low-voltage main meters, low-voltage feeder meters, circuit breaker trip units, transformer monitoring units, protective relays, and branch circuit power meters.
 - 2. Publish documented test results, including system response times, network performance, and recommended network architectures, available upon request.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Schneider Electric; Square D EcoStruxure Power; www.se.com/#sle.
- B. Source Limitations: Furnish products produced by same manufacturer as electrical distribution equipment for project and obtained from single supplier.

2.02 ELECTRICAL POWER MANAGEMENT SYSTEM (EPMS) - GENERAL REQUIREMENTS

- A. Basis of Design: Schneider Electric; Square D EcoStruxure Power; www.se.com/#sle.
- B. Provide data and analytics functionality for energy performance optimization, power reliability/availability, and sustainability metrics. Provide features, including but not limited to, real-time monitoring, alarming/event management, energy, power, and sustainability data analytics/visualization to facilitate the following functions:
 - 1. Analyze energy usage and uncover savings opportunities.
 - 2. Meet and exceed energy efficiency and sustainability standards and certifications.
 - 3. Measure return on investment of energy capital projects.
 - 4. Decrease frequency and duration of unplanned outages.
 - 5. Improve workplace safety by minimizing exposure to electrical hazards.
 - 6. Provide accurate and automated documentation for regulatory compliance.
 - 7. Improve effectiveness of equipment maintenance activities.
 - 8. Manage multiple power generation sources effectively.
 - 9. Increase return on electrical distribution assets.
- C. Data and analytics for EPMS operations, including but not limited to, centralized display, analysis, logging, alarming, and event recording to be accessible from computer workstation with supported operating system and interface software.
- D. Software Licenses:
 - 1. License software programs provided with EPMS to Owner for use on specified system.
 - 2. Do not restrict Owner from using software on system provided or its replacement.
 - 3. Grant Owner right to make copies of software for use on system provided.
 - 4. Subject to review and approval by Owner and Engineer.
- E. Computer Hardware:
 - 1. Provided by Owner, meeting EPMS supplier's minimum requirements, and supplied to EPMS supplier for configuration.
 - 2. Use current-generation, PC-based architectures with Microsoft operating systems.
- F. Connected Equipment and Devices:
 - 1. Provide EPMS network-connected devices as required to support specified EPMS functionality.
 - 2. For equipment containing connected devices, provide internal wired communications network to provide single point of connection to EPMS network.
- G. Communications and Interfaces:
 - 1. EPMS Network: Provide EPMS network using Ethernet, except where specifically indicated otherwise, for communication between EPMS system and connected equipment/devices, including but not limited to the following:
 - a. Serial communication connections as indicated to gateway devices for Ethernet EPMS network interface.
 - 2. Cybersecurity: Comply with best practices and provide technical features to reduce risk to people, assets, and processes, including:
 - a. Secure network architecture.
 - b. User privilege/authentication policy.

- c. Comply with IEC 62443 standards series, including but not limited to IEC TS 62443-1-1, IEC 62443-2-1, IEC TR 62443-2-3, IEC 62443-2-4, IEC TR 62443-3-1, IEC 62443-3-3, IEC 62443-4-1, and IEC 62443-4-2.
- 3. Equipment Interfaces:
 - a. Equipment Connected to EPMS: Provide interface compatible with EPMS network/software and required appurtenances, including gateways, transceivers, and converters, integral to equipment.
 - b. Unless otherwise indicated, use Modbus TCP/IP Ethernet protocol. Use Modbus serial only where specifically indicated.

2.03 ELECTRICAL DISTRIBUTION MONITORING AND ALARMING

- A. Provide screens displaying real-time data from electrical infrastructure, such as incoming utility feeds, medium-voltage distribution, and low-voltage distribution.
- B. Display relevant real-time data from energy meters and other facility metadata, such as WAGES, industrial process data, weather, and occupancy, from connected, compatible devices, equipment, and systems.
- C. Organize and display real-time data of EPMS software to provide logical views for system health and support EPMS applications.
- D. Provide set of screens for electrical single-line diagram of facility, including:
 - 1. Links to navigate between various levels of single-line diagram.
 - 2. Electrical parameters for equipment components on single-line diagram, such as MV switchgear, MV transformers, generators, unit substations, LV switchboards, UPS, and isolated panel system.
 - 3. Link to power equipment details screens.
- E. Equipment Details:
 - 1. Provide screens to display details pertaining to each piece of equipment, including equipment picture (if available), local single-line diagram (if applicable), information for each electrical section (e.g., breaker and disconnect switch), and alarm points.
 - 2. Measured peak demand and loading of equipment (e.g., breakers, UPSs, transformers, and generators).
 - 3. Navigation link to default diagrams of each applicable meter/protection device.
- F. Provide summary status screen for alarm indication for major power equipment components of electrical distribution system.
- G. Alarms:
 - 1. Organize abnormal electrical conditions, events, and group-related incidents using alarm management practices for situational awareness and actionable intelligence.
 - 2. Notify appropriate staff members of alarms through email or SMS text messages.

2.04 POWER QUALITY (PQ) MONITORING AND COMPLIANCE

- A. Monitor electrical disturbances, such as harmonics, unbalance, flicker, and over/under voltage conditions, to assist in reporting, analysis of conditions, and diagnoses of events.
- B. Provide screens and reports specific to PQ, including:
 - 1. Device Level PQ Summary Screen: Data collected by compliant PQ-capable metering device summarized to display:
 - a. Voltage Disturbances: Date/time of last disturbance, count of transient events, and count of sag/swell events.
 - b. Harmonic Measurements: Include navigation link to harmonics log for device.
 - c. Real-Time Harmonic Distortion Measurements: Total harmonic distortion (THD) content and maximum THD.

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- d. Flicker measurements.
 - e. Logged Events: Include navigation link to event log for device.
 - f. Waveform Logs: Include navigation link for waveforms captured during transients and sag/swell events.
 - g. Detailed waveform analysis tools.
 - 2. System Level PQ Summary Screen: Provide PQ report displaying PQ events collected for one or more metered points within given time period.
 - a. Provide summary table of events within given time period and navigation link to event details (power quality details report).
 - b. Provide plot of Information Technology Industry Council (ITIC) curve that displays worst disturbance from each event listed in summary table, with the following for each event:
 - 1) Event identifier.
 - 2) Source.
 - 3) Event timestamp.
 - 4) Phase identifier for worst disturbance (e.g., "V1").
 - 5) Voltage magnitude for worst disturbance in percentage of nominal (e.g., "68.8 percent").
 - 6) Voltage magnitude maximum and minimum on phases V1, V2, and V3 for worst disturbance in percentage of nominal.
 - 7) Duration for worst disturbance in seconds (e.g., "0.084 seconds").
 - 8) Disturbance type for worst disturbance (e.g., "sag").
 - 9) ITIC tolerance curve violations (e.g., "outside tolerance").
 - 10) Link to details report.
 - 11) Link to waveform report for worst disturbance.
 - c. Provide link in each summary table entry to additional details for event, including:
 - 1) Disturbance event timestamp.
 - 2) Phase identifier.
 - 3) Voltage magnitude in percentage of nominal (e.g., "68.8 percent").
 - 4) Voltage magnitude maximum and minimum on phase V1, V2, and V3 in percentage of nominal.
 - 5) Duration in seconds.
 - 6) Disturbance type.
 - 7) ITIC tolerance curve violations (e.g., "outside tolerance").
 - 8) Link to waveform report.
 - d. Provide navigation link in each summary table entry for waveforms of events, if available. Display waveforms for voltage and current readings of measuring point.
 - 3. Disturbance Direction Detection:
 - a. For PQ-compliant devices, indicate direction of disturbance within electrical distribution system in event logs, with associated confidence/certainty rating, such as 'Upstream: Confidence Rating - High', or "Downstream: Confidence Rating – Medium".
- C. PQ Analytics:
- 1. PQ Analytics Key Performance Indicators (KPIs):
 - a. PQ Downtime Impact: Display current count and trend over time for grid and facility PQ events and electrical system downtime in hours with associated cost.
 - b. Power Factor Impact: Display current value and trend over time for average power factor and estimated penalties/surcharges incurred.
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- c. PQ Index: Display overall health indicator and trend over time representing baseline for overall PQ of facility, based on analysis of PQ events and limits/thresholds defined by established PQ standards. Calculate index over various time periods and assign value on scale of "A" to "F", with "A" representing optimal and "F" representing poor.
 - d. PQ Event Categorization: Display event type, likely origin, and potential impact to operations in accordance with thresholds recommended by recognized PQ standards. Support flexible time periods and trending over time periods.
- 2. PQ Disturbance Indicator Analytics:
 - a. Calculate and display summary screen with high-level health indicators (red, yellow, green) for each type of PQ event/disturbance.
 - b. Evaluated PQ Events/Disturbances:
 - 1) PQ Events: Voltage sags/dips, voltage swells, voltage transients, voltage interruptions, and over/under voltages.
 - 2) PQ Disturbances: Harmonic distortion, voltage/current unbalance, frequency variation, and flicker.
 - c. Provide aggregate count or maximum/average values, depending on event/disturbance type.
 - d. For each PQ event/disturbance type, provide access to detailed information as applicable to event type, including source of event (device), timestamp, potential impact, duration, and magnitude.

2.05 POWER EVENTS RECORDING AND ANALYSIS

- A. Provide event aggregation and analysis tools to gather timestamped events from compatible connected devices to provide consolidated system event view, showing date/time ordered list of events, event priority, and reporting device name.
- B. Automatically acquire onboard event data and associated waveforms from power quality monitoring devices without additional software configuration or data upload scheduling.
- C. Retrieve onboard, high-resolution timestamps of one-millisecond accuracy without degradation or modification, including devices supporting clock synchronization via GPS, IRIG-B, NTP, or precision time protocol (PTP).

2.06 EPMS SOFTWARE

- A. Basis of Design: Schneider Electric; Square D EcoStruxure Power Monitoring Expert; www.se.com/#sle.
- B. Provide dedicated, edge control, software platform designed as operational interface for EPMS to manage safe, reliable, and efficient power within buildings/facilities.
- C. Provide specialized data acquisition, visualization, analysis, and reporting tools designed for power management applications.
- D. Support minimum of 100 devices designed for power distribution and power quality (PQ) monitoring, including programmable power analyzers, power meters, branch/multi-circuit meters, smart panels with communicating circuit breakers, protective relays, uninterruptible power supplies, active harmonic filters, capacitor bank controllers, and electrical distribution thermal sensors.
- E. Provide native device support, without requiring additional installation or configuration, including:
 - 1. Registers premapped to standard measurement names.
 - 2. Set of factory device graphical screens.
 - 3. Factory-tested support.
- F. Cybersecurity: Comply with IEC 62443-4-1 and IIEC 62443-4-2 at component level.
- G. Certify for use in energy data management system in accordance with the following:

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1. ISO 50001:
 - a. Energy review.
 - b. Energy baseline.
 - c. Energy performance indicators.
 - d. Monitoring, measurement, and analysis.
 - e. Input to management review.
 2. ISO 50002:
 - a. Data collection.
 - b. Measurement plan.
 - c. Analysis.
 - d. Energy audit reporting.
 3. ISO 50006:
 - a. Obtain relevant energy performance information from energy review.
 - b. Identify energy performance indicators.
- H. Natively support continuous electrical thermal monitoring system with capability to detect abnormal bus bar or cable temperatures due to loose/faulty connections in order to prevent equipment damage and fire.
- I. Natively support active arc flash protection system with capability to detect/display arc flash alarm.
- J. Real Time Monitoring:
1. Support creation of diagrams representing power monitoring system, including electrical one-line diagrams, facility maps, plan views, floor layouts, equipment representations, and mimic displays. Provide graphic library with standard electrical one-line symbols.
 2. Support graphical trending of real-time measurements supported by metered connected electrical equipment.
 3. Support creation of interactive, side-by-side visualizations of real-time measurements, including:
 - a. Display tabular and trend line views to compare readings from multiple devices.
 - b. Create, modify, view, and share table views directly, without additional software.
 - c. Support both physical and virtual devices defined in system.
 - d. Support exporting of real-time data into Excel formats, without additional software.
 4. Provide automatic network diagram creation feature to support automatic creation of linked hierarchical graphical diagrams for connected devices.
 5. Support advanced power quality meters with integral high-speed power analysis and disturbance direction detection (DDD); include set of real-time graphical objects for use in electrical diagrams to indicate:
 - a. Type of power quality disturbance (sag, swell, transient).
 - b. Direction of PQ disturbance relative to reporting DDD device (upstream, downstream).
 6. Provide real-time indication of aggregated demand measured by one or more devices in predefined zone, including:
 - a. Zone demand expressed using kW or normalized kW/area.
 - b. Visual indication of present zone demand comparison with four configurable limits/ targets, using color scale.
 - c. Different values for configurable limits during on-peak and off-peak periods.
- K. Alarm/Event Analysis and Notification:
1. Support acquisition of specialized high-speed power disturbance data from advanced PQ meters for power events analysis, including:
 - a. Timestamped power events with disturbance direction detection (DDD).
 - b. Timestamped high-speed (1/2-cycle sample rate) pre/post event RMS data.
 - c. Pre/post event waveform captures (voltage and current, for all phases).
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2. Provide alarm annunciator to display number of unacknowledged alarms with categorization into high, medium, and low priority, with navigation to alarm viewer.
 3. Support analysis of cascading power events, including:
 - a. Automatic, intelligent clustering of events into grouped alarms, and multiple alarms from multiple devices into incidents.
 - b. Automatic categorization of alarms and incidents into predefined categories, including power quality, power availability, and diagnostics.
 - c. Predefined views for events, alarms, and incidents with navigation and configurable filters based on priority, status, source, and categories.
 - d. Creation of private or shared views with custom filters.
 - e. Access to details on location, time, and nature of alarm or incident, with associated information including power disturbance and power quality data.
 - f. Graphical indication of power disturbance direction for alarms and incidents captured by DDD-capable devices.
 4. Provide graphical timeline view of alarms and events constituting incidents in electrical distribution network, including:
 - a. Display alarms/events stacked by order of time for sequence of events analysis.
 - b. Display start and end of alarms/events.
 - c. Indicate direction of incident with associated captured waveforms.
 - d. Display pre- and post-event high speed RMS data from supported PQ meters.
 5. Support sending of email notifications based on changes to system, including:
 - a. Communication Loss: Sent on loss of communication with selected devices.
 - b. Alarm Summary: Sent regularly to indicate changes in average amount of high-, medium-, and low-priority alarms.
 - c. Real-Time Analog and Digital Setpoints: Include options for time delays and custom alarm labels.
 - d. Dynamic Setpoints: Designed for WAGES energy and power alarms based on historical average, standard deviation, or maximum, with options for time ranges, aggregation periods, multipliers, and comparison of time periods.
 - e. Power Quality Event: Sent regularly to indicate change in average amount, duration, and magnitude of sag, swell, and transient power disturbances.
 - f. Energy Usage: Sent when energy exceeds normal range for current day and time.
- L. Data Analytics and Visualization:
1. Provide interactive, web-based dashboard application for water, air, gas, electric, steam (WAGES) data, historical data trends, power quality, images, and external content from URL addresses.
 2. Provide capability to create, modify, view, and share dashboards, including graphics, labels, scaling, measurements, and date ranges, without additional software.
 3. Support creation and configuration of kiosk slideshow displays to run independently on computer with browser in unattended mode, scrolling through designated dashboards at configurable time interval.
 4. Provide library of graphical objects (gadgets):
 - a. Standard: Include bar, pie, trend, real time, and web portal.
 - b. Specialized Energy Usage: Include period over period comparison, pareto charts, heat map/carpet plot, and sankey diagrams.
 5. Provide interactive, web-enabled interactive reports application with capability to generate, modify, save, and manage reports based on pre-engineered report templates for:
 - a. Energy billing, verification, and allocation.
 - b. Energy management and performance.
 - c. Power quality performance and compliance.
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- d. System average RMS variation frequency index (SARFI).
 - e. Operation and performance for electrical equipment, such as breakers, UPSs, and generators.
6. Support automatic distribution of reports via email or shared folder on scheduled basis, based on event, or manual export including .csv, .xlsx, .pdf, .tiff, .html, and .xml formats.
- M. Technical Infrastructure:
- 1. Support installation on physical computer or virtual machine, on Server and non-Server class Windows operating systems.
 - 2. Support SQL Server, including Enterprise, Standard, and Express editions.
 - 3. Only require SQL Server Database Engine Services and Basic Management Tools; do not require additional SQL components, such as Analysis Services or Reporting Services.
 - 4. Cybersecurity:
 - a. Support encrypted transmission of data between software platform server and web clients using transport layer security (TLS) version 1.2.
 - b. Support secure authentication between software platform server and web clients using certification authority (CA) certificates.
 - c. Support encryption and hashing of system credentials using AES256 and SHA-512, respectively.
 - d. Support installation in environment complying with Federal Information Processing Standards (FIPS).
 - 5. Support integration of Windows Active Directory across multiple domains, including:
 - a. Login using Windows credentials.
 - b. Enforcement of password complexity and expiration policies via Windows.
 - c. Role-based access control (RBAC).
 - 6. Automatically acquire onboard data, including events, trends, and waveforms, from natively supported device types without additional software configuration or data upload scheduling.
 - 7. Retrieve onboard, high-resolution (1 ms) timestamps of one-millisecond accuracy without degradation or modification, including devices supporting clock synchronization via GPS, IRIG-B, NTP, or precision time protocol (PTP).
 - 8. Support logical device definitions based on inputs/outputs or channels on devices representing downstream circuits, including:
 - a. User interface for device and measurement mapping.
 - b. Bulk-import capability to create large numbers of logical devices without manual single-device configuration.
 - 9. Support real-time and historical data aggregation within defined hierarchy views (e.g., tenants/racks/circuits, PDUs/RPPs/panels, or buildings/floors/rooms), or user-defined hierarchy view, including:
 - a. Web-based, end-user interface.
 - b. Automatic, intelligent data aggregation across hierarchy nodes for data visualization in dashboards, trends, and reports.
 - c. Creation of virtual devices to enable net metering, common area allocation, and apportionment.
 - d. Updating of hierarchy node names and associated time ranges to accurately represent and report facility changes (e.g., tenant move-in/out).
 - e. Bulk-import capability to create and edit large hierarchies without manual per-device setup.
 - 10. Device-Level Modbus Integration:
 - a. Modbus master to read/write registers in Modbus devices for monitoring and control applications.
 - b. User interface to create and manage Modbus device definitions/drivers and association of device graphic template screens.
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11. OPC Data Access Server 2.01 Support:
 - a. Provide default OPC server tag mappings for natively supported device types without requiring manual mapping of device registers to OPC tags.
 - b. Add or change OPC mappings or add custom measurements.
12. OPC Data Access Client 2.01 Support:
 - a. User interface to create and manage OPC device definitions/drivers and association of device graphic template screens.
 - b. Built-in OPC Test Client.
13. Web Services Interoperability:
 - a. Web services server to share real-time, historical (i.e., timestamped trend data), and alarm (i.e., timestamped event strings) data to other web services client applications.
 - b. User interface for web services configuration and mapping.
 - c. Ability to acknowledge alarms by authenticated and authorized clients.
14. Provide extract, transform, and load (ETL) engine to exchange data between files, databases, and systems, including:
 - a. User interface to specify connection information, data formats, measurement mappings, and schedules.
 - b. Support for importing data from .csv and .xml data files, AVEVA Historian databases, and third-party databases via OledB connections.
15. Support system-wide programming extensibility, using graphical, object-oriented application engine capable of logic and arithmetic functions, database queries, XML data import, complex logic-based alarming and data logging, and email/text notifications.
16. Remain online during system administration functions, including communications, logging, and alarming; do not require operator to take system offline.
17. Support internationalization and regional settings, with factory support for simplified Chinese, traditional Chinese, English, French, German, Italian, Russian, Spanish, Polish, Czech, and Swedish languages. Support capability to change default language without additional installation or advanced software configuration.
18. Support offline software configuration management for efficient system deployments and upgrades with dedicated user interface for creating, copying, and deploying software configuration projects.

N. Products:

1. Schneider Electric; Square D EcoStruxure Power Monitoring Expert; www.se.com/#sle.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install equipment in accordance with manufacturer's written instructions.

3.02 FIELD QUALITY CONTROL

- A. Manufacturer Services: Provide services of manufacturer's field representative to perform functional testing, commissioning, and first parameter adjusting.
1. On-site commissioning to be performed by factory-trained personnel using automated commissioning tools.

3.03 CLOSEOUT ACTIVITIES

- A. Functional Demonstration Testing: As part of commissioning, manufacturer's field representative to demonstrate proper operation of EPMS and associated systems under normal operating conditions and simulated scenarios.
- B. Training:
1. On-Site Training: Train Owner's personnel on operation and maintenance of system.

- a. Accommodate minimum of four attendees.
- b. Provide not less than one session with four hours of hands-on training.
- c. Instructor: Factory-trained manufacturer's representative with direct experience with EPMS.
- 2. Provide sufficient time and detail in each session to cover the following at minimum:
 - a. Operation theory.
 - b. Major equipment components.
 - c. System and software function and operation.
 - d. Definition and use of various system data, such as energy, demand, power factor, load profile, time of use, and KYZ.
 - e. System architecture and communications methods.
 - f. System optimization.
 - g. Electric meter function and operation.

END OF SECTION

SECTION 26 09 23
LIGHTING CONTROL DEVICES - LUTRON

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Devices and associated accessories for automatic control of lighting and other loads:
 - 1. Wallbox timers.
 - 2. Wallbox occupancy sensors.
 - 3. Wired wallbox occupancy sensors with wireless communication inputs.
 - 4. Wired occupancy sensors.
 - 5. Wireless occupancy/vacancy sensors.
 - 6. Wireless daylight sensors.
 - 7. Wired load control modules with wireless communication inputs for wireless sensors and control stations.
 - 8. Wired wall dimmers and switches with wireless communication inputs.
 - 9. Wireless control stations.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 33.16 - Boxes for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. 47 CFR 15 - Radio Frequency Devices current edition.
- B. ASTM D4674 - Standard Practice for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Office Environments 2019.
- C. ASTM E308 - Standard Practice for Computing the Colors of Objects by Using the CIE System 2022.
- D. IEC 60929 - AC and/or DC-Supplied Electronic Control Gear for Tubular Fluorescent Lamps - Performance Requirements 2011, with Amendment (2015).
- E. IEC 61000-4-2 - Electromagnetic Compatibility (EMC) - Part 4-2: Testing and Measurement Techniques - Electrostatic Discharge Immunity Test 2008.
- F. ISO 9001 - Quality Management Systems — Requirements 2015.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- H. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2016.
- I. NEMA WD 1 - General Color Requirements for Wiring Devices 1999 (Reaffirmed 2020).
- J. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances Current Edition, Including All Revisions.
- L. UL 1472 - Solid-State Dimming Controls Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of sensors and wall controls with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate the placement of wall controls with actual installed door swings.
 - 3. Coordinate the placement of daylight sensors 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.
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4. Coordinate the work to provide luminaires and lamps compatible with the lighting controls to be installed.
5. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Sequencing:

1. Do not install sensors and wall controls until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
 1. Occupancy/Vacancy Sensors: Include detailed basic motion detection coverage range diagrams.
 2. Wall Dimmers: Include derating information for ganged multiple devices.
- C. 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.
- D. Project Record Documents: Record actual installed locations and settings for lighting controls.
- E. Operation and Maintenance Data: Include detailed information on lighting control system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
- F. Warranty: Submit sample of manufacturer's Warranty as specified in Part 1 under "WARRANTY". Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.06 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:
 1. Company with not less than ten years of experience manufacturing lighting controls, including products using wireless communication between devices.
 2. Registered to ISO 9001, including in-house engineering for product design activities.
 3. Provides factory direct technical support hotline available 24 hours per day, 7 days per week.
 4. Qualified to supply specified products and to honor claims against product presented in accordance with warranty.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.08 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.
 1. Basis of Design System Requirements - Lutron, Unless Otherwise Indicated:
 - a. Ambient Temperature:
 - 1) Lighting Controls: Between 32 and 104 degrees F.
 - b. Relative Humidity: Less than 90 percent, non-condensing.
 - c. Protect lighting controls from dust.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer's Standard Warranty:

1. Manufacturer Lighting Control System Components, Except Wallbox Occupancy Sensors, Wireless Sensors, Ballasts/Drivers and Ballast Modules: One year 100 percent parts coverage, no manufacturer labor coverage.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Basis of Design Manufacturer: Lutron Electronics Company, Inc; www.lutron.com/#sle.
- B. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL) as suitable for the purpose indicated.
- B. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, programming, etc. as necessary for a complete operating system that provides the control intent indicated.
- C. Design lighting control equipment for 10 year operational life while operating continually at any temperature in an ambient temperature range of 32 degrees F to 104 degrees F and 90 percent non-condensing relative humidity.
- D. Electrostatic Discharge Tolerance: Design and test equipment to withstand electrostatic discharges without impairment when tested according to IEC 61000-4-2.
- E. Power Failure Recovery: When power is interrupted for periods up to 10 years and subsequently restored, lights to automatically return to same levels (dimmed setting, full on, or full off) as prior to power interruption.
- F. Wireless Devices:
 1. Capable of diagnosing system communications.
 2. Capable of having addresses automatically assigned to them.
 3. Receives signals from other wireless devices and provides feedback to user.
 4. Capable of determining which devices have been addressed.
 5. RF Frequency: 434 MHz; operate in FCC governed frequency spectrum for periodic operation; continuous transmission spectrum is not permitted.
 6. RF Range: 60 feet line-of-sight or 30 feet through typical construction materials between RF transmitting devices and compatible RF receiving devices.
 7. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application.
- G. Device Finishes:
 1. Standard Colors: Comply with NEMA WD 1 where applicable.
 2. Color Variation in Same Product Family: Maximum delta E of 1, CIE L*a*b color units per ASTM E308.
 3. Visible Parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.

2.03 WALLBOX TIMERS

- A. Provide warning to occupant of impending load turn-off.
- B. Product(s):
 1. Type - Wallbox Timer; Lutron Maestro Series Countdown Timer Control Switch, Model MA-T51: 120 V, 600 W/VA (5 A) lighting (incandescent/halogen, magnetic low voltage), 3 A general purpose fan; adjustable from 5 to 60 minutes with option for untimed full on; minimum load requirement.

2.04 WALLBOX OCCUPANCY SENSORS

A. General Requirements:

1. Passive Infrared Sensing:
 - a. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
 - b. Passive infrared coupled with technology for sensing fine motions; Lutron XCT Technology. Signal processing technology detects fine-motion passive infrared (PIR) signals without the need to change the sensor's sensitivity threshold.
2. Ultrasonic Sensing: Utilize an operating frequency of 32 kHz or 40 kHz, crystal-controlled to operate within plus/minus 0.005 percent tolerance.
3. Dual Technology Sensing: Passive infrared and ultrasonic sensing coupled with technology for sensing very fine motions; Lutron XCT Technology. Signal processing technology detects fine-motion passive infrared (PIR) and ultrasonic signals without the need to change the sensor's sensitivity threshold.

B. Wall Switch Occupancy/Vacancy Sensors; Lutron Maestro Series:

1. General Requirements:
 - a. Turns off lighting after reasonable and adjustable time delay once the last person to occupy the space vacates a room or area. Provide adjustable timeout settings of 1, 5, 15, and 30 minutes.
 - b. Switches at point of minimum energy to maximize relay life, actively adapting to variations in relay timing.
 - c. Suitable for incandescent, halogen, electronic low-voltage, magnetic low-voltage, compact fluorescent, LED, magnetic fluorescent, electronic fluorescent, and fan loads.
 2. Passive Infrared Wall Switch Combination Occupancy/Vacancy Sensors:
 - a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
 - b. Adjustable sensitivity (high, low presets).
 - c. Selectable option to enable low light feature (automatic-on when ambient light is below threshold). Ambient light threshold to be adaptive utilizing occupant feedback; Lutron Smart Ambient Light Detection.
 - d. Selectable option to inhibit automatic turn-on of lights after manual-off operation while room is occupied for applications such as presentation viewing in conference rooms and classrooms; when room is vacated, returns to normal automatic-on operation after time delay period.
 3. Passive Infrared Wall Switch Vacancy-Only Sensors:
 - a. Operates only as a vacancy sensor (manual-on and automatic-off) in accordance with California Title 24 requirements.
 - b. Adjustable sensitivity (high, low presets).
 4. Dual Technology Wall Switch Combination Occupancy/Vacancy Sensors:
 - a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
 - b. Adjustable sensitivity (high, medium, low, and off presets) individually for passive infrared and ultrasonic sensing.
 - c. Selectable option to enable low light feature (automatic-on when ambient light is below threshold). Ambient light threshold to be selectable as either adaptive utilizing occupant feedback (Lutron Smart Ambient Light Detection) or as fixed (high, medium, low, and ultra low presets).
 - d. Selectable option to inhibit automatic turn-on of lights after manual-off operation while room is occupied for applications such as presentation viewing in conference rooms and classrooms.
 5. Dual Technology Wall Switch Vacancy-Only Sensors:
 - a. Operates only as a vacancy sensor (manual-on and automatic-off) in accordance with California Title 24 requirements.
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- b. Adjustable sensitivity (high, medium, low, and off presets) individually for passive infrared and ultrasonic sensing.
 - 6. Dual-Circuit Passive Infrared Wall Switch Combination Occupancy/Partial-On Sensors:
 - a. Each circuit programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a partial-on sensor (manual-on and automatic-off).
 - b. Adjustable sensitivity (high, low presets).
 - c. Selectable option to enable low light feature (automatic-on when ambient light is below threshold) or to inhibit automatic turn-on of lights after manual-off operation while room is occupied for applications such as presentation viewing in conference rooms and classrooms; applicable for auto-on only. Ambient light threshold to be adaptive utilizing occupant feedback; Lutron Smart Ambient Light Detection.
 - d. Timeout settings to be individually adjustable for each circuit.
 - e. Independent manual switching for each circuit.
 - 7. Dual-Circuit Passive Infrared Wall Switch Partial-On Sensors:
 - a. Operates only as a partial-on sensor (one circuit auto-on and auto-off and one circuit manual-on and automatic-off) in accordance with California Title 24 requirements.
 - b. Adjustable sensitivity (high, low presets).
 - c. Selectable option to enable low light feature (automatic-on when ambient light is below threshold) or to inhibit automatic turn-on of lights after manual-off operation while room is occupied for applications such as presentation viewing in conference rooms and classrooms; applicable for auto-on only. Ambient light threshold to be adaptive utilizing occupant feedback; Lutron Smart Ambient Light Detection.
 - d. Timeout settings to be individually adjustable for each circuit.
 - e. Independent manual switching for each circuit.
 - 8. Dual-Circuit Dual Technology Wall Switch Combination Occupancy/Partial-On Sensors:
 - a. Each circuit programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a partial-on sensor (manual-on and automatic-off).
 - b. Adjustable sensitivity (high, medium, low, and off presets) individually for passive infrared and ultrasonic sensing.
 - c. Selectable option to enable low light feature (automatic-on when ambient light is below threshold). Ambient light threshold to be selectable as either adaptive utilizing occupant feedback (Lutron Smart Ambient Light Detection) or as fixed (high, medium, low, and ultra low presets); applicable for auto-on only.
 - d. Selectable option to inhibit automatic turn-on of lights after manual-off operation while room is occupied for applications such as presentation viewing in conference rooms and classrooms; applicable for auto-on only.
 - e. Timeout settings to be individually adjustable for each circuit.
 - f. Independent manual switching for each circuit.
 - 9. Companion Switches: Provide as required for multi-location control as indicated.
 - a. Product(s): As specified in Section 26 27 26.
 - C. Wall Dimmer Occupancy Sensors; Lutron Maestro LED+ Sensor Dimmer Series:
 - 1. General Requirements;
 - a. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472.
 - b. Adjustable sensitivity (high, low presets).
 - c. Adjustable auto-on light level (100 percent, 50 percent, last light level, locked presets).
 - d. Turns off lighting after reasonable and adjustable time delay once the last person to occupy the space vacates a room or area. Provide adjustable timeout settings of 1, 3, 5, 15, and 30 minutes.
 - e. Provide fade-to-off operation to warn occupant of impending load turn-off.
 - f. Suitable for dimmable incandescent, halogen, compact fluorescent, and LED loads.
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2. Passive Infrared Wall Dimmer Combination Occupancy/Vacancy Sensors:
 - a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
 - b. Selectable options to enable low light feature (automatic-on when ambient light is below threshold) or to inhibit automatic turn-on of lights after manual-off operation while room is occupied for applications such as presentation viewing in conference rooms and classrooms (applicable for auto-on only). Ambient light threshold to be adaptive utilizing occupant feedback; Lutron Ambient Smart Light Detection.
 3. Passive Infrared Wall Dimmer Vacancy-Only Sensors:
 - a. Operates only as a vacancy sensor (manual-on and automatic-off) in accordance with California Title 24 requirements.
 4. Companion Dimmers: Provide as required for multi-location control as indicated.
 - a. Product(s): As specified in Section 26 27 26.
- D. Wall Dimmer Occupancy Sensors; Lutron Maestro Occupancy Sensor Dimmer Series:
1. General Requirements;
 - a. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472.
 - b. Adjustable sensitivity (high, low presets).
 - c. Dimmer Features: Locked preset, fade-to-on, fade-to-off.
 - d. Turns off lighting after reasonable and adjustable time delay once the last person to occupy the space vacates a room or area. Provide adjustable timeout settings of 1, 3, 5, 15, and 30 minutes.
 - e. Provide selectable option to dim lights by 50 percent to warn occupant of impending load turn-off.
 - f. Suitable for dimmable incandescent and halogen loads.
 2. Passive Infrared Wall Dimmer Combination Occupancy/Vacancy Sensors:
 - a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
 3. Passive Infrared Wall Dimmer Vacancy-Only Sensors:
 - a. Operates only as a vacancy sensor (manual-on and automatic-off) in accordance with California Title 24 requirements.
 4. Companion Dimmers: Provide as required for multi-location control as indicated.
 - a. Product(s): As specified in Section 26 27 26.
- E. 0-10 V Wall Dimmer Occupancy Sensors; Lutron Maestro 0-10 V Dimmer Sensor Series:
1. General Requirements;
 - a. Compatible with sourcing electronic 0-10 V ballasts/drivers, as per IEC 60929 Annex E.2 0-10 V protocol.
 - b. Adjustable sensitivity (high, medium, low, and minimum presets).
 - c. Adjustable high/low end trims.
 - d. Selectable dimming curve (linear or square law).
 - e. Dimmer Features: Locked preset, fade-to-on, fade-to-off.
 - f. Turns off lighting after reasonable and adjustable time delay once the last person to occupy the space vacates a room or area. Provide adjustable timeout settings of 1, 5, 15, and 30 minutes.
 - g. Selectable option to enable low light feature (automatic-on when ambient light is below threshold). Ambient light threshold to be selectable as either adaptive utilizing occupant feedback (Lutron Smart Ambient Light Detection) or as fixed (high, medium, low, and minimum presets); applicable for auto-on only.
 - h. Fades lights to off over period of 10 seconds to warn occupant of impending load turn-off.
 - i. Provides visual alert for miswire and incompatible load.
 2. Passive Infrared 0-10 V Wall Dimmer Combination Occupancy/Vacancy Sensors:
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- a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
3. Passive Infrared 0-10 V Wall Dimmer Vacancy-Only Sensors:
 - a. Operates only as a vacancy sensor (manual-on and automatic-off) in accordance with California Title 24 requirements.
4. Companion Switches: Provide as required for multi-location control as indicated.

2.05 WIRED WALLBOX OCCUPANCY SENSORS WITH WIRELESS COMMUNICATION INPUTS

- A. 0-10 V Wall Dimmer/Switch Combination Occupancy/Vacancy Sensors with Wireless Communication Inputs; Lutron Maestro Wireless 0-10 V Dimmer Sensor/Maestro Wireless Sensor Switch Series.
 1. Communicates via radio frequency with up to ten compatible wireless occupancy/vacancy sensors, ten wireless control stations, and one wireless daylight sensor.
 2. Compatible with sourcing electronic 0-10 V ballasts/drivers, as per IEC 60929 Annex E.2 0-10 V protocol.
 3. Selectable option to enable low light feature (automatic-on when ambient light is below threshold). Ambient light threshold to be selectable as either adaptive utilizing occupant feedback (Lutron Smart Ambient Light Detection) or as fixed (high, medium, low, and minimum presets).
 4. Occupancy/Vacancy Sensors:
 - a. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
 - b. Sensing Mechanism: Passive infrared coupled with technology for sensing fine motions; Lutron XCT Technology. Signal processing technology detects fine-motion passive infrared (PIR) signals without the need to change the sensor's sensitivity threshold.
 - c. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
 - d. Turns off lighting after reasonable and adjustable time delay once the last person to occupy the space vacates a room or area; adjustable timeout settings (1, 5, 15, and 30 minutes).
 - e. Adjustable sensitivity (high, medium, low, and minimum presets).
 - f. Selectable option to inhibit automatic turn-on of lights after manual-off operation while room is occupied for applications such as presentation viewing in conference rooms and classrooms; when room is vacated, returns to normal automatic-on operation after time delay period.
 - g. Selectable walk-through mode to override selected timeout and automatically turn off lights if no motion is detected within 3 minutes after initial occupancy for applications where space may be briefly occupied.
 5. Vacancy-Only Sensors:
 - a. Operates only as a vacancy sensor (manual-on and automatic-off) in accordance with California Title 24 requirements.
 - b. Adjustable sensitivity (high, medium, low, and minimum presets).
 6. Dimmer Features:
 - a. Adjustable high/low end trims.
 - b. Selectable dimming curve (linear or switched).
 - c. Selectable fade on/fade off times (15, 5, 2.5, or 0.75 sec).
 - d. Adjustable auto-on light level (fully adjustable from one to 100 percent).
 7. Dimmer Control: Multi-function tap switch with small, raised rocker for dimmer adjustment.
 - a. Rocker raises/lowers light level, with new level becoming the current preset level.
 - b. Switch single tap raises lights to preset level or fades lights to off.
 - c. Switch double tap raises light to full on level.
 8. Switch Control: Switch single tap turns lights on/off.

2.06 WIRED OCCUPANCY SENSORS

- A. General Requirements:

1. Connects directly to compatible ballasts and modules without the need of a power pack or other interface.
 2. Turns off or reduces lighting automatically after reasonable time delay when a room or area is vacated by the last person to occupy the space.
 3. Accommodates all conditions of space utilization and all irregular work hours and habits.
 4. Comply with UL 94.
 5. Self-Adaptive: Continually adjusts sensitivity and timing to ensure optimal lighting control for any use of the space.
 6. Furnished with field-adjustable controls for time delay and sensitivity to override any adaptive features.
 7. Power Failure Memory: Settings and learned parameters to be saved in non-volatile memory and not lost should power be interrupted and subsequently restored.
 8. Furnished with all necessary mounting hardware and instructions.
 9. Class 2 devices.
 10. Ceiling-Mounted Sensors: Indicate viewing directions on mounting bracket.
 11. Wall-Mounted Sensors: Provide swivel-mount base.
 12. Color: White.
- B. Wired Passive Infrared Sensors:
1. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
 2. Ceiling-Mounted Sensors: Provide customizable mask to block off unwanted viewing areas.
- C. Wired Ultrasonic Sensors:
1. Utilize an operating frequency of 32 kHz or 40 kHz, crystal-controlled to operate within plus/minus 0.005 percent tolerance.
- D. Wired Dual Technology Sensors:
1. Passive Infrared Sensing: Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
 2. Ultrasonic Sensing: Utilize an operating frequency of 32 kHz or 40 kHz, crystal-controlled to operate within plus/minus 0.005 percent tolerance.
 3. Ceiling-Mounted Sensors: Provide customizable mask to block off unwanted viewing areas.
 4. Isolated Relay: Provide an internal additional isolated relay with Normally Open, Normally Closed, and Common outputs for use with HVAC control, Data Logging and other control options where indicated.
 5. Integral Photocell: Provide an integral photocell with adjustable sensitivity to prevent lights from turning on when there is sufficient natural light where indicated.
- E. Power Packs for Wired Sensors:
1. Provide sensor power packs where required for power connection to sensors.
 2. For ease of mounting, installation and future service, power pack(s) to be able to mount through a 1/2 inch knockout in a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Transformer to provide power to a minimum of three sensors.
 3. Plenum-rated.
 4. Control Wiring Between Sensors and Control Units: Class 2, 18-24 AWG, stranded UL Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable.

2.07 WIRELESS SENSORS

- A. General Requirements:
1. Operational life of 10 years without the need to replace batteries when installed per manufacturer's instructions.
 2. Communicates directly to compatible RF receiving devices through use of a radio frequency communications link.

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3. Does not require external power packs, power wiring, or communication wiring.
 4. Capable of being placed in test mode to verify correct operation from the face of the unit.
- B. Wireless Occupancy/Vacancy Sensors:
1. General Requirements:
 - a. Provides a clearly visible method of indication to verify that motion is being detected during testing and that the unit is communicating to compatible RF receiving devices.
 - b. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
 - c. Sensing Mechanism: Passive infrared coupled with technology for sensing fine motions; Lutron XCT Technology. Signal processing technology detects fine-motion passive infrared (PIR) signals without the need to change the sensor's sensitivity threshold.
 - d. Provide optional, readily accessible, user-adjustable controls for timeout, automatic/manual-on, and sensitivity.
 - e. Turns off lighting after reasonable and adjustable time delay once the last person to occupy the space vacates a room or area. Provide adjustable timeout settings of 1, 5, 15, and 30 minutes.
 - f. Capable of turning dimmer's lighting load on to an optional locked preset level selectable by the user. Locked preset range to be selectable on the dimmer from 1 percent to 100 percent.
 - g. Color: White.
 - h. Provide all necessary mounting hardware and instructions for both temporary and permanent mounting.
 - i. Provide temporary mounting means for drop ceilings to allow user to check proper performance and relocate as needed before permanently mounting sensor. Temporary mounting method to be designed for easy, damage-free removal.
 - j. Sensor lens to illuminate during test mode when motion is detected to allow installer to place sensor in ideal location and to verify coverage prior to permanent mounting.
 - k. Ceiling-Mounted Sensors:
 - 1) Provide surface mounting bracket compatible with drywall, plaster, wood, concrete, and compressed fiber ceilings.
 - 2) Provide recessed mounting bracket compatible with drywall and compressed fiber ceilings.
 - l. Wall-Mounted Sensors: Provide wall or corner mounting brackets compatible with drywall and plaster walls.
 2. Wireless Combination Occupancy/Vacancy Sensors:
 - a. Ceiling-Mounted Sensors: Programmable to operate as an occupancy sensor (automatic-on and automatic-off), an occupancy sensor with low light feature (automatic-on when less than one footcandle of ambient light available and automatic-off), or a vacancy sensor (manual-on and automatic-off).
 - b. Wall-Mounted Sensors: Programmable to operate as an occupancy sensor (automatic-on and automatic-off), or a vacancy sensor (manual-on and automatic-off).
 3. Wireless Vacancy-Only Sensors:
 - a. Operates only as a vacancy sensor (manual-on and automatic-off) in accordance with California Title 24 requirements.
- C. Wireless Daylight Sensors:
1. Product: Lutron Radio Powr Savr Series, Model LFR2-DCRB-WH.
 2. Open-loop basis for daylight sensor control scheme.
 3. Stable output over temperature from 32 degrees F to 104 degrees F.
 4. Partially shielded for accurate detection of available daylight to prevent fixture lighting and horizontal light component from skewing sensor detection.
 5. Provide linear response from 2 to 150 footcandles.
 6. Color: White.
 7. Mounting:
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- a. Provide surface mounting bracket compatible with drywall, plaster, wood, concrete, and compressed fiber ceilings.
 - b. Provide all necessary mounting hardware and instructions for both temporary and permanent mounting.
 - c. Provide temporary mounting means for drop ceilings to allow user to check proper performance and relocate as needed before permanently mounting sensor. Temporary mounting method to be designed for easy, damage-free removal.
8. Meets California Title 24 requirements.

2.08 WIRED WALL DIMMERS AND SWITCHES WITH WIRELESS COMMUNICATION INPUTS

- A. General Requirements:
1. Utilize air gap off, activated when user selects "off" at any control to disconnect the load from line supply.
 2. Provide air gap service switch accessible without removing faceplate.
 3. Operates at the rated capacity across the full ambient temperature range including modified capacities for ganged configurations which require removal of fins.
 4. Provide radio frequency interference suppression.
 5. Surge Tolerance: Designed and tested to withstand surges of 6,000 V, 200 amps according to IEEE C62.41.2 without impairment to performance.
 6. Dimmers: Provide full range, continuously variable control of light intensity.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that ratings and configurations of devices are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive devices.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, except for mounting heights specified in those standards.
- B. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of devices provided under this section.
- C. Where multiple devices are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
- D. Install products in accordance with manufacturer's instructions.
- E. Install permanent barrier between ganged devices when voltage between adjacent devices exceeds 300 V.
- F. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 45 16 - Field Quality Control Procedures for City of Madison additional requirements.
- B. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

3.05 ADJUSTING

3.06 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

3.08 PROTECTION

- A. Protect installed products from subsequent construction operations.

END OF SECTION

**SECTION 26 09 23.13
LIGHTING CONTROL DEVICES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Occupancy sensors.
- B. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems
- C. Section 26 05 33.16 - Boxes for Electrical Systems.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 05 73 - Power System Studies.
- F. Section 26 27 26 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.
 - 1. Includes finish requirements for wall controls specified in this section.
 - 2. Includes accessory receptacles, switches, dimmers and wall plates, to match lighting controls specified in this section.
- G. Section 26 28 13 - Fuses.
- H. Section 26 29 13 - Enclosed Controllers: General purpose contactors.
- I. Section 26 51 00 - Interior Lighting.

1.03 REFERENCE STANDARDS

- A. 47 CFR 15 - Radio Frequency Devices; current edition.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- D. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices; 2017.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.
- G. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2020.

1.04 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 of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.
 - B. Sequencing:
-

1. Do not install lighting control devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required 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.
- 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 60 00 - Product Requirements, for additional provisions.

1.06 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. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 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.

1.08 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Provide five year manufacturer warranty for all occupancy sensors.
- C. Provide five year manufacturer warranty for utility grade locking receptacle-mounted outdoor photo controls.
- D. Provide two year manufacturer warranty for all daylighting controls.

PART 2 PRODUCTS

2.01 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.

2.02 OCCUPANCY SENSORS

- A. Manufacturers:

-
1. Sensor Switch Inc; CMR series for ceiling mount and WSX for wall switches with occupancy sensing: www.sensorswitch.com/#sle.
 2. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
- B. 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/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. Sensitivity: Field adjustable.
 9. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
 10. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on drawings.
 11. Isolated Relay for Low Voltage Occupancy Sensors: SPDT dry contacts, ratings as required for interface with system indicated.
 12. Where wired sensors are indicated, wireless sensors are acceptable provided that all components and wiring modifications necessary for proper operation are included.
- C. Wall Switch Occupancy Sensors:
1. All Wall Switch Occupancy Sensors:
 - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
 - b. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.
 - c. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.
 - d. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
 - e. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
 - f. Finish: Match finishes specified for wiring devices in Section 26 27 26, unless otherwise indicated.
 2. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.
- D. Wall Dimmer Occupancy Sensors:
1. General Requirements:
-

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- a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated dimming control capability, and no leakage current to load in off mode.
 - b. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
 - c. Manual-Off Override Control Capability: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
 - d. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.
 - e. Provide field adjustable dimming preset for occupied state.
 - f. Provide fade-to-off operation to notify occupant of impending load turn-off.
 - g. Finish: Match finishes specified for wiring devices in Section 26 27 26, unless otherwise indicated.
- E. 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:
 - a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 - b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 15 feet, with a field of view of 360 degrees.
- F. Directional Occupancy Sensors:
- 1. All Directional Occupancy Sensors: Designed for wall or ceiling mounting, with integral swivel for field adjustment of motion detection coverage.
 - a. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
 - b. Provide field selectable setting for disabling LED motion detector visual indicator.
 - c. Finish: White unless otherwise indicated.
 - 2. Passive Infrared/Ultrasonic Dual Technology Directional Occupancy Sensors: Capable of detecting motion within a distance of 40 feet at a mounting height of 10 feet.
- G. 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.

2.03 ACCESSORIES

- A. Auxiliary Contacts:
- 1. Comply with NEMA ICS 5.

2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each lighting contactor, minimum.

PART 3 EXECUTION

3.01 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.

3.02 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.

3.03 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. Install lighting control relays furnished under Section 25 36 26
- C. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of lighting control devices provided under this section.
 1. Mounting Heights: Unless otherwise indicated, as follows:
 - a. Wall Switch Occupancy Sensors: 48 inches above finished floor.
 2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
 3. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
- D. Install lighting control devices in accordance with manufacturer's instructions.
- E. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- F. Install lighting control devices plumb and level, and held securely in place.
- G. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 27 26.
- H. Provide required supports in accordance with Section 26 05 29.
- I. 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.
- J. Identify lighting control devices in accordance with Section 26 05 53.
- K. Occupancy Sensor Locations:

1. Location Adjustments: Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage.
 2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.
- L. Lamp Burn-In: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.
- M. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.
- N. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.
- O. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.
- P. Where indicated or required, provide cabinet or enclosure in accordance with Section 26 05 33.16 for mounting of lighting control device system components.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - 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.

3.05 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.
- C. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.
- D. 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.

3.06 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 COMMISSIONING

- A. See Section 01 91 00 - Commissioning for City of Madison commissioning requirements.

3.08 CLOSEOUT ACTIVITIES

- A. See Section 01 77 00 - Closeout Procedures, for closeout submittals.
- B. See Section 01 79 00 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of lighting control devices to Architect, 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 21 00
LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical service requirements.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Materials and installation requirements for cast-in-place concrete equipment pads.
- B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
- C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- D. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- E. Section 26 05 33.13 - Conduit for Electrical Systems.
- F. Section 26 05 33.23 - Surface Raceways for Electrical Systems: Wireways.
- G. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- H. Section 26 24 16 - Panelboards: Service entrance equipment.
- I. Section 26 27 13.13 - Power and Energy Meters: Non-utility electrical metering.
- J. Section 26 27 13.16 - Power Quality Meters.
- K. Section 26 31 00 - Photovoltaic Collectors: Photovoltaic system for interconnection with normal utility electrical supply.
- L. Section 26 43 00 - Surge Protective Devices: Service entrance surge protective devices.
- M. Section 31 23 16 - Excavation.
- N. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.
- O. Section 31 23 23 - Fill: Bedding and backfilling.

1.03 PRICE AND PAYMENT PROCEDURES

- A. Allowances:
1. Reference Division 01 for allowances affecting this section.
 2. Include cash allowance for Utility Company charges associated with providing service.
- B. Unit Prices:
1. Reference Division 01 for additional unit price requirements.
 2. Primary:
 - a. Basis of Measurement: By the lineal foot, for each configuration.
 - b. Basis of Payment: Includes all work designated to be provided by Contractor in "Division of Responsibility" under Part 2 article "Electrical Service Requirements" below, including purchase, delivery, and installation.
 3. Secondary:
 - a. Basis of Measurement: By the lineal foot, for each configuration.
 - b. Basis of Payment: Includes all work designated to be provided by Contractor in "Division of Responsibility" under Part 2 article "Electrical Service Requirements" below, including purchase, delivery, and installation.
 4. Transformer Pad/Vault:
 - a. Basis of Measurement: Per unit, for each type.
 - b. Basis of Payment: Includes purchase, delivery, and installation.

1.04 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.

1.05 REFERENCE STANDARDS

- A. IEEE C2 - National Electrical Safety Code(R) (NESC(R)) 2023.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.06 ADMINISTRATIVE REQUIREMENTS

- A. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.
- B. Coordination:
 - 1. Verify the following with Utility Company representative:
 - a. Utility Company requirements, including division of responsibility.
 - b. Exact location and details of utility point of connection.
 - c. Utility easement requirements.
 - d. Utility Company charges associated with providing service.
 - 2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.
 - 3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 4. Coordinate the work with other installers to provide communication lines required for Utility Company meters.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.
- D. Utility Company charges associated with providing permanent service to be paid by Owner.
- E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.
- F. Scheduling:
 - 1. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.
 - 2. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.07 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
 - B. Utility Company letter of availability for providing electrical service to project.
 - C. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product. Include ratings, configurations, standard wiring diagrams, outline and support point dimensions, finishes, weights, service condition requirements, and installed features.
 - D. Shop Drawings: Include dimensioned plan views and sections indicating locations and arrangement of Utility Company and service entrance equipment, metering provisions, required clearances, and proposed service routing.
 - 1. Obtain Utility company approval of shop drawings prior to submittal.
 - E. Drawings prepared by Utility Company.
 - F. Project Record Documents: Record actual locations of equipment and installed service routing.
-

1.08 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.
 - 4. The requirements of the local authorities having jurisdiction.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- 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.

1.09 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**2.01 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. Utility Company: As indicated on drawings.
- D. Division of Responsibility: Per Utility Company requirements.
- E. Products Furnished by Contractor: Comply with Utility Company requirements.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- 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.

3.02 PREPARATION

- A. Verify and mark locations of existing underground utilities.

3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and Utility Company requirements.
 - B. Perform work in accordance with NECA 1 (general workmanship).
 - C. Arrange equipment to provide minimum clearances and required maintenance access.
 - D. Provide required trenching and backfilling in accordance with Section 31 23 16.13.
 - E. Construct cast-in-place concrete pads for utility equipment in accordance with Utility Company requirements and Section 03 30 00.
 - F. Provide required protective bollards in accordance with Utility Company requirements.
-

- G. Provide required support and attachment components in accordance with Section 26 05 29.
- H. Provide grounding and bonding for service entrance equipment in accordance with Section 26 05 26.
- I. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 26 05 53.

3.04 PROTECTION

- A. Protect installed equipment from subsequent construction operations.

END OF SECTION

SECTION 26 24 13.11
SWITCHBOARDS - SCHNEIDER ELECTRIC SQUARE D FLEXSET / QED-2

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 27 13.13 - Power and Energy Meters - Schneider Electric PowerLogic.
- C. Section 26 27 13.16 - Power Quality Meters - Schneider Electric PowerLogic.
- D. Section 26 4313 - Surge Protective Devices for Power Circuits.

1.02 ABBREVIATIONS AND ACRONYMS

- A. EPMS: Electrical power management system.
- B. ERMS: Energy reduction maintenance setting.
- C. SPD: Surge protective device.

1.03 DEFINITIONS

- A. Switchboards may also be identified as SWBD.

1.04 REFERENCE STANDARDS

- A. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011 (Reaffirmed 2017).
- B. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
- C. ISO 9001 - Quality Management Systems — Requirements; 2015.
- D. ISO 14001 - Environmental Management Systems — Requirements with Guidance for Use; 2015.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- F. NECA 400 - Standard for Installing and Maintaining Switchboards; 2007.
- G. NEMA PB 2 - Deadfront Distribution Switchboards; 2011.
- H. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 1000 Volts or Less; 2023.
- I. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. NFPA 70B - Recommended Practice for Electrical Equipment Maintenance; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.
- M. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- N. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- O. UL 891 - Switchboards; Current Edition, Including All Revisions.
- P. UL 1066 - Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Provide sufficient information to determine compliance with Contract Documents. Identify submittal data with specific equipment tags and/or service descriptions to which they pertain. Identify specific model numbers, options, and features of equipment proposed.
- C. Indicate deviations from Contract Documents with reference to corresponding drawing or specification number and written justification for deviation.
- D. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchboards, enclosures, overcurrent protective devices, components, and accessories.
- E. Shop Drawings: Indicate dimensions, voltage, bus ampacities, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, instruments, features, and accessories.
 - 1. Include dimensioned plan and elevation views of switchboards; indicate dimensions, weights, shipping splits, and required clearances.
 - 2. Include one-line diagram.
- F. Manufacturer's qualification statement.
- G. Operation and Maintenance Data:
 - 1. Provide detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
 - 2. Digital Record Keeping:
 - a. Provide maintenance logbook application/website available on PC/mobile device to assist in compliance with NFPA 70B.
 - b. Include access to manufacturer's standard documentation, equipment serial number, as-built drawings, assembly and testing results, device settings, and spare parts list.
 - c. Provide password-protected access to Owner.
 - d. Provide access via scannable QR code on front face of equipment.
- H. Specimen Warranty: Statement of standard warranty.
- I. Executed warranty.
- J. Project Record Documents:
 - 1. Construction, installation, schematic, and wiring diagrams updated to as-installed and commissioned state.
 - 2. Configured settings/parameters for adjustable components updated to as-installed and commissioned state, noted if different from factory default.
- K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
 - 1. See Section 01 60 00 - Product Requirements for additional provisions.
 - 2. Spare Parts: For each type and size of unit installed.
 - a. Provide minimum spare parts recommended by manufacturer.
 - b. Fuses: One set of each type of power and control fuse installed within equipment.
 - c. Touch-up paint for finishes.
 - d. Package and mark spare parts for long-term storage. Provide separate anti-static containers for printed circuit boards.
 - 3. Tools: Manufacturer-specific special tools required to install, remove, test, and maintain switchboard components.

1.06 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. NFPA 70.
 - 2. Requirements of local authorities having jurisdiction.
-

3. Applicable local codes.
- B. Manufacturer Qualifications:
 1. Firm engaged in manufacture of specified products of types and sizes required, and whose products have been in satisfactory use in similar service for minimum of 20 years.
 2. Certified in accordance with ISO 9001 with applicable quality assurance system regularly reviewed and audited by third-party registrar. Develop and control manufacturing, inspection, and testing procedures under guidelines of quality assurance system.
 3. Service, repair, and technical support services available 24 hours per day, 7 days per week from manufacturer or their representative.
 4. Certified in accordance with ISO 14001, with product environmental profiles (PEPs) for specified products.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Prior to delivery to project site, verify suitable storage space is available to store materials in well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres.
- B. Protect materials during delivery and storage and maintain within manufacturer's written storage requirements. At minimum, store indoors in clean, dry space with uniform temperature to prevent condensation and protect electronics from potential damage from electrical and magnetic energy.
- C. Deliver materials to project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and equipment tag number or service name as identified in Contract Documents.
- D. Inspect products and report concealed damage or violation of delivery, storage, and handling requirements to Engineer.

1.08 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide manufacturer warranty for defects in material and workmanship for 12 months from date of commissioning or 18 months from date of shipment, whichever comes first. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Schneider Electric; Square D FlexSeT or QED-2 per project requirements; www.se.com/#sle.
- B. ABB; <https://global.abb/group/en>
- C. Source Limitations: Furnish products produced by same manufacturer as other electrical distribution equipment for project and obtained from single supplier.

2.02 LOW-VOLTAGE SWITCHBOARDS

- A. Basis of Design: Schneider Electric; Square D FlexSeT or QED-2 per project requirements; www.se.com/#sle.
- B. Switchboard Ratings/Configurations: As indicated on drawings.
- C. Switchboard Assemblies:
 1. Comply with NEMA PB 2; list and label as complying with UL 891.
 2. Provide front and rear alignment of adjacent sections.
 3. Provide barriers between sections.

-
- D. Short Circuit Current Rating: Where not specified, provide switchgear with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- E. Cable Terminations for Incoming Conductors:
1. Provide lugs in quantity and size required for conductors indicated on drawings.
 2. Lug Type: Aluminum mechanical lugs, suitable for terminating aluminum or copper conductors unless otherwise indicated; rate for 167 degrees F (75 degrees C).
- F. Bussing:
1. Bus Density Rating: Standard, in accordance with UL 891 temperature rise requirements.
 2. Bus Material: Hard-drawn, silver-plated copper of 98 percent conductivity unless otherwise indicated.
 3. Plating: Apply to bus surfaces except cut edges. Plating on contact surfaces only is not permitted.
 4. Phase and Neutral Horizontal Bus: Ampacity equal to or greater than switchboard system rating. Tapered bus is not permitted.
 5. Group-Mounted Feeder Vertical Bus Stack:
 - a. Provide capability to mount feeder breakers with different frame sizes/poles across from one another on bus stack.
 - b. Design to remove nonconducting surface films during circuit breaker installation by wiping action of circuit breaker jaws.
 - c. Design in conjunction with circuit breaker jaws to create blow-on forces under fault conditions.
 - d. Bolted connections for group-mounted feeder breakers are not permitted.
 6. Ground Bus:
 - a. Size in accordance with NFPA 70 and UL 891.
 - b. Bus Material: Hard-drawn copper of 98 percent conductivity.
 - c. Equip with pressure connectors for feeder and branch circuit equipment grounding conductors.
- G. Enclosures:
1. Construction: Steel.
 2. UL 50E Rating, Unless Otherwise Indicated:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Indoor Locations with Fire Sprinkler Protection: Type 1 with drip hood.
 - c. Outdoor Locations: Type 3R.
 3. Front Covers: Removable with single tool.
 4. Doors: Hinged with removable hinge pins.
 5. Finish: Manufacturer's standard paint color over rust-inhibiting primer on treated metal surface.
- H. Future Provisions:
1. Future Switchboard Sections: Equip horizontal bus with splicing hardware for additional switchboard sections.
 2. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit breaker compartment.
- I. Markings and Labeling:
1. Provide identification and warning labels/nameplates exterior to equipment resistant to weather, UV, and intended installation environment.
 2. Provide engraved nameplate identifying project-specific equipment tag and service description.
 3. Provide warning labels/nameplates complying with ANSI Z535.4 at access locations to advise personnel of possible hazards in accordance with listing, NFPA 70, NFPA 70E, and other applicable standards.
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4. Provide scannable QR code on front face of equipment for access to maintenance logbook application/website available on PC/mobile device.
- J. Maintenance Mode Switches:
1. Description: Local, lockable switch with blue status indicator light that permits selection of maintenance mode with alternate electronic trip unit settings for reduced fault clearing time in accordance with NFPA 70.
 2. Provide for circuit breakers 1,200 A and larger and where indicated on drawings, unless providing other means of reducing clearing time in accordance with NFPA 70.
 3. Switch Type: Provide energy reduction maintenance settings (ERMS) switches or maintenance mode settings (MMS) switches as indicated.
 - a. ERMS Switches: Clearing time of less than 50 milliseconds when activated.
 - b. MMS Switches: Clearing time of less than 80 milliseconds when activated.
- K. Surge Protective Device (SPD):
1. See Section 26 4313 for additional information.
- L. Power Metering:
1. Factory installed, integrated within switchboard.
 2. Applications:
 - a. Low-Voltage Mains: Power and energy meter.
 3. Power and Energy Meters:
 - a. Capable of monitoring for network management, energy cost allocation, asset management, operational efficiency, and compliance reporting.
 - b. Products:
 - 1) Schneider Electric PowerLogic PM5500 meter.
 - 2) ABB; <https://global.abb/group/en>
- M. Communications:
1. Provide internal wired communications network for connection to Owner's network for power monitoring and equipment status/alarm information via:
 - a. Connection to building management system, electrical power management system (EPMS), or other software.
 2. Communications Protocol: Ethernet Modbus TCP/IP network connected via daisy-chain architecture from each circuit breaker and separate meters (where specified) upstream to switchboard Ethernet port.
 3. Provide software for adjusting circuit breaker trip/alarm points, displaying trip curves, and updating firmware.
 4. Internal Network Wiring: Shielded cables with pluggable connectors to facilitate connection across shipping splits.

2.03 OVERCURRENT PROTECTIVE DEVICES

- A. Circuit Breakers:
1. Interrupting Capacity: As required to provide short circuit current rating indicated.
 2. Insulated Case Circuit Breakers (ICCBs):
 - a. Description: Quick-make, quick-break circuit breakers with two-step stored energy closing mechanism; maximum five-cycle closing time.
 - b. Listed and labeled as complying with UL 489.
 - c. Construction:
 - 1) Provide fixed-mount circuit breakers unless otherwise indicated.
 - d. Electronic Trip Units:
 - 1) Microprocessor based, with circuit breaker status display and LED trip indicators.
 - 2) Provide energy reduction maintenance settings (ERMS).
-

- 3) Provide network monitoring capability for amperage, voltage, power, energy, and harmonics.
 - 4) Provide capability to upgrade by uploading digital modules without requiring replacement/modification of hardware.
 - 5) Where indicated on drawings, provide electronic trip units with field-adjustable long-time and instantaneous protection settings.
 - e. Products:
 - 1) Schneider Electric; MasterPact MTZ series.
 - 2) ABB; <https://global.abb/group/en>
3. Power Circuit Breakers (PCBs):
 - a. Description: Quick-make, quick-break circuit breakers with two-step stored energy closing mechanism; maximum five-cycle closing time.
 - b. Listed and labeled as complying with UL 1066.
 - c. Construction:
 - 1) Provide fixed-mount circuit breakers unless otherwise indicated.
 - d. Electronic Trip Units:
 - 1) Microprocessor based, with circuit breaker status display and LED trip indicators.
 - 2) Provide energy reduction maintenance settings (ERMS).
 - 3) Provide network monitoring capability for amperage, voltage, power, energy, and harmonics.
 - 4) Provide capability to upgrade by uploading digital modules without requiring replacement/modification of hardware.
 - 5) Where indicated on drawings, provide electronic trip units with field-adjustable long-time and instantaneous protection settings.
 - e. Products:
 - 1) Schneider Electric; MasterPact MTZ series.
 - 2) ABB; <https://global.abb/group/en>
4. Molded Case Circuit Breakers (MCCBs):
 - a. Comply with FS W-C-375; listed and labeled as complying with UL 489.
 - b. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 - c. Circuit Breaker Type:
 - 1) Provide thermal magnetic circuit breakers unless otherwise indicated.
 - d. Products:
 - 1) Schneider Electric; PowerPacT series.
 - 2) ABB; <https://global.abb/group/en>

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine equipment exterior and interior for damage, including but not limited to, structure, moisture, and mildew.
- B. Examine for conditions detrimental to completion of work, including:
 1. Verify concrete pads are level and free of irregularities.
 2. Verify installation space is enclosed and weatherproof.
 3. Verify wet work located in or in close proximity to switchboard installation location is completed and dry.

3.02 INSTALLATION

- A. Install equipment in accordance with manufacturer's written instructions.
- B. Install switchboards in accordance with NECA 1, NECA 400, and NEMA PB 2.1.

- C. Unless otherwise indicated, install and anchor switchboards on raised concrete pad 4 inches (100 mm) high; see Section 03 30 00.
- D. Set field-adjustable circuit breaker tripping function settings as determined by coordination study.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Manufacturer Services: Provide services of manufacturer's field representative to perform functional testing, commissioning, and first parameter adjusting.
 - 1. Include necessary material, equipment, labor, and technical supervision.
 - 2. Replace damaged or malfunctioning equipment and report discrepancies or installation issues.
 - 3. Identify switchboards with label indicating inspection/testing agency and date of service.
- C. Operational Readiness Testing:
 - 1. Inspect and test equipment and associated systems for conformance to Contract Documents, including equipment manufacturer's recommendations, and readiness for operation.
 - a. Visually inspect for physical damage and proper installation.
 - b. Perform tests in accordance with manufacturer's instructions.
 - c. Perform tests to verify compliance with Contract Documents.
 - d. Perform tests to verify equipment is ready for operation.
 - e. Touch-up paint chips and scratches with manufacturer-supplied paint.
 - f. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
 - g. Measure, using high potential testing, insulation resistance of each bus structure phase-to-phase and phase-to-ground for one minute each, at minimum test voltage of 1,000 VDC.
 - 1) Comply with manufacturer's documented specific testing procedures.
 - 2) Minimum Insulation Resistance: 1 megohm.
 - h. Physically test key interlock systems for proper functionality prior to energizing.
 - i. Test continuity of each circuit.
 - j. Perform each electrical test and visual/mechanical inspection listed in NETA ATS as applicable. Certify compliance with test parameters.
 - 1) Switchboards: See Section 7.1.
 - 2) Fusible Switches: See Section 7.5.
 - 3) Circuit Breakers: See Section 7.6.
 - 4) Relays: See Section 7.9.
 - 5) Instrument Transformers: See Section 7.10.
 - 6) Meters: See Section 7.11.
 - 7) Ground Fault Protection Systems: See Section 7.14.
 - D. Correct deficiencies and replace damaged or defective switchboards or associated components.

3.04 PROTECTION

- A. Protect installed switchboards from subsequent construction operations.

END OF SECTION

SECTION 26 24 16.11
PANELBOARDS - SCHNEIDER ELECTRIC SQUARE D NQ - NF

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Lighting and appliance panelboards.
- B. Molded case circuit breakers.

1.02 RELATED REQUIREMENTS

- A. Section 26 09 13.13 - Electrical Power Management System - Schneider Electric Square D EcoStruxure PME.
- B. Section 26 27 13.13 - Power and Energy Meters - Schneider Electric PowerLogic.
- C. Section 26 27 13.16 - Power Quality Meters - Schneider Electric PowerLogic.
- D. Section 26 43 00 - Surge Protective Devices.

1.03 ABBREVIATIONS AND ACRONYMS

- A. CT: Current Transformer.
- B. MVP: Measurement and Verification Panels.

1.04 DEFINITIONS

- A. Panelboards may also be identified as LP.

1.05 REFERENCE STANDARDS

- A. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels 2011 (Reaffirmed 2017).
- B. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service 2013e, with Amendment (2017).
- C. ISO 9001 - Quality Management Systems — Requirements 2015.
- D. ISO 14001 - Environmental Management Systems — Requirements with Guidance for Use 2015.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- F. NEMA PB 1 - Panelboards 2011.
- G. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000 Volts or Less 2023.
- H. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. NFPA 70E - Standard for Electrical Safety in the Workplace 2024.
- J. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.
- K. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.
- L. UL 67 - Panelboards Current Edition, Including All Revisions.
- M. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures Current Edition, Including All Revisions.
- N. UL 1449 - Standard for Surge Protective Devices Current Edition, Including All Revisions.

1.06 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
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- B. Provide sufficient information to determine compliance with Contract Documents. Identify submittal data with specific equipment tags and/or service descriptions to which they pertain. Identify specific model numbers, options, and features of equipment proposed.
- C. Indicate deviations from Contract Documents with reference to corresponding drawing or specification number and written justification for deviation.
- D. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, components, and accessories.
- E. Shop Drawings: Indicate dimensions, voltage, bus ampacities, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, instruments, features, and accessories.
 - 1. Include details for environmental protection, interior mounting dimensions, and wiring gutter dimensions.
 - 2. Indicate location of main, branch circuits, and solid neutral, where applicable.
 - 3. Include one-line diagrams with applicable voltage systems.
- F. Manufacturer's qualification statement.
- G. Operation and Maintenance Data:
 - 1. Provide detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
 - 2. Manufacturer's installation instructions and NEMA PB 1.1.
- H. Specimen Warranty: Statement of standard warranty.
- I. Executed warranty.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
 - 1. See Section 01 60 00 - Product Requirements for additional provisions.
 - 2. Panelboard Keys: One for each lock.
 - 3. Spare Parts: For each type and size of unit installed.
 - a. Provide minimum spare parts recommended by manufacturer.
 - b. Package and mark spare parts for long-term storage.
 - 4. Tools: Manufacturer-specific special tools required to install, remove, test, and maintain panelboard components.

1.07 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. NFPA 70.
 - 2. Requirements of local authorities having jurisdiction.
 - 3. Applicable local codes.
- B. Manufacturer Qualifications:
 - 1. Firm engaged in manufacture of specified products of types and sizes required, and whose products have been in satisfactory use in similar service for minimum of 50 years.
 - 2. Certified in accordance with ISO 9001 with applicable quality assurance system regularly reviewed and audited by third-party registrar. Develop and control manufacturing, inspection, and testing procedures under guidelines of quality assurance system.
 - 3. Service, repair, and technical support services available 24 hours per day, 7 days per week from manufacturer or their representative.
 - 4. Certified in accordance with ISO 14001.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Prior to delivery to project site, verify suitable storage space is available to store materials in well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres.

- B. Protect materials during delivery and storage and maintain within manufacturer's written storage requirements. At minimum, store indoors in clean, dry space with uniform temperature to prevent condensation and protect electronics from potential damage from electrical and magnetic energy.
- C. Deliver materials to project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and equipment tag number or service name as identified in Contract Documents.
- D. Inspect products and report concealed damage or violation of delivery, storage, and handling requirements to Engineer.

1.09 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

- A. See Section 01 77 00 - Closeout Submittals for City of Madison additional warranty requirements.
- B. Manufacturer Warranty: Provide manufacturer warranty for defects in material and workmanship for 12 months from date of commissioning or 18 months from date of shipment, whichever comes first. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Schneider Electric; Square D NQ and NF; www.se.com/#sle.
- B. ABB/GE; <https://global.abb/group/en>
- C. Source Limitations: Furnish products produced by same manufacturer as other electrical distribution equipment for project and obtained from single supplier.

2.02 LIGHTING AND APPLIANCE PANELBOARDS

- A. Basis of Design: Schneider Electric; Square D NQ and NF; www.se.com/#sle.
- B. Comply with NEMA PB 1; listed and labeled as complying with UL 67.
- C. Short Circuit Current Rating: Where not specified, provide panelboards with listed short circuit current rating not less than available fault current at installed location as indicated on drawings.
- D. Provide panelboards marked for use as service equipment where required for application.
- E. Panelboard Interiors:
 - 1. 240 VAC and 48 VDC Maximum Panelboards:
 - a. Continuous main current ratings up to 600 A.
 - b. Available Circuit Capacity: Up to 84 circuits.
 - c. Minimum Short Circuit Current Rating:
 - 1) 240 VAC:
 - (a) Series Rated: 10 kA.
 - (b) Fully Rated: 10 kA.
 - 2) 48 VDC: 5 kA.
 - d. Provide branch circuit connectors suitable for both plug-on and bolt-on branch circuit breakers.
 - e. Circuit Breaker Orientation:
 - 1) Main Circuit Breakers up to 150 A: Horizontally mounted.
 - 2) Main Circuit Breakers Above 150 A: Vertically mounted.
 - 3) Sub-Feed Circuit Breakers: Vertically mounted.
 - f. Products:
 - 1) Schneider Electric Square D NQ.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.

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2. Bussing:
 - a. Provide sequentially phased branch circuit connectors for each bus bar.
 - b. Provide fully rated bussing with one continuous bus bar per phase, unless otherwise indicated.
 - 1) Split-Bus and Separated-Distribution Panelboards:
 - (a) Provide one continuous bus bar per phase for each branch distribution section.
 - (b) Split-Bus Panelboard Sections: Connected from upstream lugs or branch circuit breaker to one back-fed main circuit breaker in downstream section.
 - (c) Separated-Distribution Panelboard Sections: Connected via removable, stranded copper cables, secured via mechanical lugs on each section.
 - c. Determine bus current ratings in accordance with UL 67 heat-rise tests.
 - d. Maximum current ratings apply for main-lug-only or main-circuit-breaker panelboards.
 - e. Rated 100 A to 400 A: Plated aluminum.
 - f. Rated 600 A and Above: Plated copper.
 - g. Run bus bar plating entire length of bus bar.
 - h. Predrill interior phase bus to accommodate field-installed options (e.g., sub-feed lugs, sub-feed breakers, thru-feed lugs).
 3. Neutral:
 - a. Panelboards 20 inches Nominal and Wider: Plated, solid, and split.
 - b. Panelboards 14 inches Wide and Column Width: Plated and solid.
 4. Ground:
 - a. Provide solidly bonded aluminum equipment ground bar.
 5. Interiors in Type 1 and 2 Enclosures:
 - a. Field convertible for top or bottom incoming feed.
 - b. Provide interior leveling provisions for flush mounting applications.
 6. Interior Trim: Dead-front construction to shield energized parts, with filler plates to cove unused mounting spaces.
 7. Main-Lug Interiors up to 600 A: Field-convertible to main circuit breaker.
- F. Enclosures:
1. Comply with UL 50 and UL 50E.
 2. Key all lock assemblies alike.
 3. Mount clear plastic directory cardholder or welded metal frame directory cardholder on inside of door.
 4. Type 1 Enclosures:
 - a. Provide surface-mounted or flush-mounted enclosures as indicated on drawings.
 - b. Boxes:
 - 1) Hot zinc dipped galvanized steel; unpainted galvanized steel is not acceptable.
 - 2) Provide removable end walls with knockouts at one end.
 - 3) Provide standard 5.75-inch deep enclosures with permanently affixed interior mounting studs; provide interior mounting brackets as required.
 - 4) Box Width:
 - (a) Standard Box Width: 20 inches; provide box widths of 26 inches or 27 inches where required by application.
 - c. Fronts:
 - 1) Finish: ANSI 49 gray enamel paint baked onto cleaned, phosphatized steel.
 - 2) Provide one-piece fronts with door.
 - 3) Provide doors with rounded corners and edges, free of burrs.
 - 4) Provide cylindrical tumbler-type lock with catch and spring-loaded steel door pull, quarter-turn fasteners, or three-point latch.
 5. Type 3R, 5, and 12 Enclosures:
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- a. Finish: ANSI 49 gray enamel paint baked onto cleaned, phosphatized steel.
 - b. Provide gasketed doors for Type 5 and Type 12 enclosures.
 - c. Provide at least one L-Handle lock mechanism. For enclosures 59 inches or more in height, provide additional L-Handle mechanism or two additional quarter-turn fasteners.
 - d. Nominal Enclosure Dimensions:
 - 1) Type 3R, 5, and 12 Enclosures: 21 inches wide and 6.75 inches, excluding handle.
 - 2) Door-in-Door Type 12 Enclosures: 21 inches wide and 8.75 inches deep, excluding handle.
 - 3) Vented Type 3R Enclosures: 27 inches wide and 8.75 inches deep, excluding handle.
6. Type 4 and 4X Enclosures:
- a. Provide gasketed doors.
 - b. Provide L-Handle lock mechanism.
 - c. Provide additional clamps or fasteners on top, bottom, and/or side for tight closure.
 - d. Nominal Enclosure Dimensions: 23 inches wide and 7.25 inches deep, excluding handle.
- G. Markings and Labeling:
- 1. Provide identification and warning labels/nameplates exterior to equipment resistant to weather, UV, and intended installation environment.
 - 2. Provide engraved nameplate identifying project-specific equipment tag and service description.
 - 3. Provide warning labels/nameplates complying with ANSI Z535.4 at access locations to advise personnel of possible hazards in accordance with listing, NFPA 70, NFPA 70E, and other applicable standards.
 - 4. Provide nameplates containing system information and catalog number or factory order number.
 - 5. Display interior wiring diagram, neutral wiring diagram, and short circuit current rating on interior or in booklet format.
- H. Surge Protective Device (SPD):
- 1. Listed as complying with UL 1449.
 - 2. Surge Current Rating:
 - a. Service Entrance Locations: Not less than 240 kA per phase.
 - 3. Provide surge counter and visible display.
 - 4. Connect to each phase bus; locate close to main incoming lugs or main circuit breaker.
 - 5. 240 VAC Maximum Panelboards:
 - a. Field installable; attach to bus in branch circuit section; manufactured by panelboard manufacturer.
 - b. Products:
 - 1) Schneider Electric SurgeLogic SurgeLoc series.
 - 6. 600Y/347 VAC Maximum Panelboards:
 - a. Factory installed, integrated within panelboard.
 - b. Products:
 - 1) Schneider Electric SurgeLogic IMA series.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.

2.03 MOLDED CASE CIRCUIT BREAKERS

- A. Description: Quick-make, quick-break circuit breakers with over-center, trip-free toggle mechanism; ratings, configurations, and features/accessories as indicated on drawings.
 - B. Comply with FS W-C-375; listed labeled as complying with UL 489.
 - C. Interrupting Capacity: As required to provide short circuit current rating indicated.
 - D. Multi-Pole Circuit Breakers: Provide common tripping for all poles.
 - E. Thermal Magnetic Circuit Breakers:
 - 1. Provide permanent trip unit with thermal and magnetic trip elements in each pole.
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2. Thermal Elements: True RMS-sensing, factory calibrated to operate in 104 degrees F ambient temperature; ambient compensating above 104 degrees F.
- F. Vertically Mounted Main Circuit Breakers and Sub-Feed Circuit Breakers:
1. Trip Units:
 - a. Up to 400 A: Thermal magnetic.
 - b. Above 400 A: Electronic trip.
 2. Electronic Trip Units:
 - a. Basic Electronic Trip Units: Provide adjustable trip current.
 - b. Where indicated on drawings, provide electronic trip units with field-adjustable long-time and instantaneous protection settings.
 - c. Provide current transformers combining iron-core sensors for self-powered electronics and air-core, Rogowski coil sensors for measurement accuracy.
 3. Provide push-to-trip button for maintenance and testing purposes.
 4. Indicate rated ampacity on circuit breaker handle and faceplate.
 5. Listed for reverse connection without restrictive line or load markings.
 6. Frame Sizes Above 125 A: Provide single magnetic trip adjustment on front of circuit breaker to simultaneously select desired trip level of all poles.
 7. Provide escutcheon with international I/O markings in addition to standard ON/OFF markings.
 8. Lugs:
 - a. Listed to accept solid or stranded copper and aluminum conductors.
 - b. Listed to accept 75 degree C rated wire.
 - c. Bolt lug body in place; snap-in designs are not acceptable.
 9. Listed for use with the following accessories:
 - a. Shunt trip.
 - b. Undervoltage trip.
 - c. Ground fault shunt trip.
 - d. Auxiliary switch.
 - e. Alarm switch.
 - f. Mechanical lug kits.
 - g. Compression lug kits.
 - h. Handle Locking Provisions: For locking handle in ON or OFF position.
 10. Products:
 - a. Schneider Electric; Square D PowerPacT series.
- G. Horizontally Mounted and Back-Fed Main Circuit Breakers:
1. Trip Units: Thermal magnetic.
 2. Operating Range: Between 14 degrees F and 140 degrees F.
 3. Provide two forms of visible trip indication:
 - a. Circuit breaker handle resides in position between ON and OFF.
 - b. Red Visi-Trip indicator appears in clear window of circuit breaker housing.
 4. Lugs:
 - a. Listed to accept solid or stranded copper and aluminum conductors.
 - b. Listed to accept 75 degree C rated wire.
 5. Listed for use with the following factory-installed accessories:
 - a. Shunt trip.
 - b. Auxiliary switch.
 - c. Alarm switch.
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PART 3 EXECUTION**3.01 EXAMINATION**

- A. Examine equipment exterior and interior for damage, including but not limited to, structure, moisture, and mildew.
- B. Examine for conditions detrimental to completion of work.

3.02 INSTALLATION

- A. Install equipment in accordance with manufacturer's written instructions.
- B. Install panelboards in accordance with NECA 1 and NEMA PB 1.1.
- C. Maintain proper phasing for multi-wire branch circuits.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 45 16 - Field Quality Control Procedures for City of Madison additional requirements.
- B. Manufacturer Services: Provide services of manufacturer's field representative to perform functional testing, commissioning, and first parameter adjusting.
 - 1. Include necessary material, equipment, labor, and technical supervision.
 - 2. Replace damaged or malfunctioning equipment and report discrepancies or installation issues.
- C. Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.
- D. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads within 20 percent of each other.
- E. Inspect tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver in accordance with manufacturer's written specifications.

3.04 PROTECTION

- A. Protect installed panelboards from subsequent construction operations.

END OF SECTION

SECTION 26 27 13.13
POWER AND ENERGY METERS - SCHNEIDER ELECTRIC POWERLOGIC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Power meters.
- B. Energy meters.
- C. Multi-meter unit cabinets.

1.02 RELATED REQUIREMENTS

- A. Section 26 09 13.13 - Electrical Power Management System - Schneider Electric Square D EcoStruxure PME.

1.03 ABBREVIATIONS AND ACRONYMS

- A. EPMS: Electrical power management system.

1.04 REFERENCE STANDARDS

- A. 47 CFR 15 - Radio Frequency Devices current edition.
- B. ANSI C12.20 - American National Standard for Electricity Meters - 0.1, 0.2, and 0.5 Accuracy Classes 2018, with Errata.
- C. IEC 61000-6-5 - Electromagnetic Compatibility (EMC) – Part 6-5: Generic Standards – Immunity for Equipment Used in Power Station and Substation Environment 2015 (Corrigendum 2017).
- D. IEC 61326-1 - Electrical Equipment for Measurement, Control and Laboratory Use – EMC Requirements – Part 1: General Requirements 2020.
- E. IEC 61557-12 - Electrical Safety in Low Voltage Distribution Systems Up to 1 000 V AC and 1 500 V DC - Equipment for Testing, Measuring or Monitoring of Protective Measures - Part 12: Power Metering and Monitoring Devices (PMD) 2018 (Corrigendum 2022).
- F. IEC 62053-22 - Electricity Metering Equipment - Particular Requirements - Part 22: Static Meters for AC Active Energy (Classes 0,1S,0,2S and 0,5S) 2020.
- G. ISO 9001 - Quality Management Systems — Requirements 2015.
- H. ISO 14001 - Environmental Management Systems — Requirements with Guidance for Use 2015.
- I. ISO 50001 - Energy Management Systems – Requirements with Guidance for Use 2018.
- J. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.
- L. UL 508A - Industrial Control Panels Current Edition, Including All Revisions.
- M. UL 61010-1 - Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Provide sufficient information to determine compliance with Contract Documents. Identify submittal data with specific equipment tags and/or service descriptions to which they pertain. Identify specific model numbers, options, and features of equipment proposed.
- C. Indicate deviations from Contract Documents with reference to corresponding drawing or specification number and written justification for deviation.

- D. Shop Drawings: Include system interconnection schematic diagrams showing factory and field connections.
- E. Manufacturer's qualification statement.
- F. Operation and Maintenance Data:
 - 1. Provide detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
 - a. Include manufacturer, supplier, support, and repair center contact information.
 - b. Include manufacturer's standard operation and maintenance data assembled for each size and type of equipment furnished.
 - c. Include contact information for parts stocking location closest to Owner.
 - d. Identify critical spare parts associated with long lead times and/or those critical to unit operation.
 - e. Identify maintenance spare parts required to regularly perform scheduled equipment maintenance including, but not limited to, consumable parts required to be exchanged during scheduled maintenance periods.
- G. Executed warranty.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
 - 1. See Section 01 60 00 - Product Requirements for additional provisions.
 - 2. Spare Parts: For each type and size of unit installed.
 - a. Provide minimum spare parts recommended by manufacturer.
 - b. Fuses: One set of each type of power and control fuse installed within equipment.
 - c. Package and mark spare parts for long-term storage. Provide separate anti-static containers for printed circuit boards.
 - 3. Tools: Manufacturer-specific special tools required to install, remove, test, and maintain metering components.

1.06 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. NFPA 70.
 - 2. Requirements of local authorities having jurisdiction.
 - 3. Applicable local codes.
- B. Manufacturer Qualifications:
 - 1. Firm engaged in manufacture of specified products of types and sizes required, and whose products have been in satisfactory use in similar service for minimum of 10 years.
 - 2. Certified in accordance with ISO 9001 with applicable quality assurance system regularly reviewed and audited by third-party registrar. Develop and control manufacturing, inspection, and testing procedures under guidelines of quality assurance system.
 - 3. Service, repair, and technical support services available 24 hours per day, 7 days per week from manufacturer or their representative.
 - 4. Certified in accordance with ISO 14001, with product environmental profiles (PEPs) for specified products.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Prior to delivery to project site, verify suitable storage space is available to store materials in well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres.
- B. Protect materials during delivery and storage and maintain within manufacturer's written storage requirements. At minimum, store indoors in clean, dry space with uniform temperature to prevent condensation and protect electronics from potential damage from electrical and magnetic energy.

- C. Deliver materials to project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and equipment tag number or service name as identified in Contract Documents.
- D. Inspect products and report concealed damage or violation of delivery, storage, and handling requirements to Engineer.

1.08 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

- A. See Section 01 77 00 - Closeout Submittals for City of Madison additional warranty requirements.
- B. Manufacturer Warranty: Provide manufacturer warranty for defects in material and workmanship for 18 months from date of invoice. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Schneider Electric; PowerLogic; www.se.com/#sle.
- B. Source Limitations: Furnish products produced by same manufacturer as other electrical distribution equipment for project and obtained from single supplier.

2.02 GENERAL REQUIREMENTS

- A. List as complying with UL 61010-1.
- B. Certified for use in energy management systems in accordance with ISO 50001.
- C. Electromagnetic Compatibility:
 - 1. Comply with IEC 61000-6-5 and IEC 61326-1.
 - 2. Comply with FCC requirements of 47 CFR 15, Class B.

2.03 POWER METERS

- A. Capable of monitoring for network management, energy cost management, energy allocation, and operational efficiency.
- B. Construction:
 - 1. Form Factor: 1/4 DIN with cut-out of 3.6 by 3.6 inches and panel-mount integrated display of 3.8 by 3.8 inches.
 - 2. Capable of mounting in enclosure panel/door without tools.
 - 3. Provide removable connectors for voltage inputs, control power, communications, and auxiliary inputs/outputs.
- C. Voltage and Current Inputs:
 - 1. Support direct connection of low-voltage circuits up to 600 VAC without requiring voltage (potential) transformers.
 - 2. Provide four metered 5 A nominal current inputs for 3-phase measurement plus neutral.
- D. Control Power: 100-480 VAC/125-250 VDC.
- E. Measured and Calculated Metering Parameters: Support full range of 3-phase voltage, current, power, and energy measurements, power factor, frequency, total harmonic distortion (THD), and individual power harmonics readings (up to 63rd order).
- F. Measurement Accuracy:
 - 1. Provide four-quadrant metering and sample current/voltage simultaneously without gaps with 64 samples per cycle (zero blind).
 - 2. ANSI C12.20; Class 0.2.
 - 3. IEC 61557-12; Class 0.2.

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- G. Display:
 - 1. Provide backlit dot-matrix LCD, anti-glare and scratch resistant with minimum of 128 by 128 pixels.
 - 2. Capable of displaying four values per screen.
 - 3. Provide summary screen to view snapshot of system.
 - 4. Support integrated or remote display.
 - H. Input/Outputs:
 - 1. Support four digital inputs for demand sync pulse, time sync input, and conditional energy control.
 - 2. Provide two digital outputs that operate by user command sent over communication link or in response to user-defined alarm/event.
 - 3. Provide four digital inputs configurable for input metering with on-board pulse weight calculation and conversion to standard units for external water, air, gas, electrical, or steam (WAGES) meters.
 - I. Communications:
 - 1. Support serial RS485 Modbus, Ethernet Modbus TCP, Ethernet BACnet IP (BTL listed), DNP over Ethernet, and Ethernet IP.
 - 2. Provide two Ethernet ports for daisy-chain wiring from meter to meter.
 - 3. Support serving data over Ethernet network accessible through web browser with default pages from factory.
 - 4. Support upgradeable firmware to enhance functionality through Ethernet or serial communication connection for upgrades of individual meters or groups.
 - 5. Provide integrated gateway functionality to enable connection via Ethernet to downstream, serially connected devices.
 - J. Onboard Logging:
 - 1. Provide capability to log data, alarms, and events, including data logs, minimum/maximum log files of selected parameter values, and alarm logs for each user-defined alarm/event.
 - 2. Nonvolatile Memory: Support 14 parameters every 15 minutes for 90 days.
 - K. Alarming:
 - 1. Support 29 setpoint-driven alarms, 4 digital alarms, 4 unary alarms, 10 Boolean alarms and 5 custom alarms.
 - 2. Support user-definable alarm events.
 - 3. Support setpoint-driven alarms for voltage/current parameters, input status, and end-of-interval status.
 - 4. Support generation of email/text message notifications upon alarm condition via simple mail transfer protocol (SMTP).
 - 5. Support management and monitoring of devices on IP network via simple network management protocol (SNMP) with delivery of alarm condition by SNMP traps.
 - L. Products:
 - 1. Schneider Electric; PowerLogic PM5000 series.

2.04 ENERGY METERS

- A. Capable of monitoring circuits for energy cost management, energy allocation, and operational efficiency.
 - B. Operating Temperature: Between minus 13 degrees F and 158 degrees F.
 - C. Construction:
 - 1. Self-enclosed to prevent exposure to live parts and protect sensitive electronics when enclosure cabinet is open.
 - 2. Snap-on meters, removable for serviceability.
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- D. Voltage and Current Inputs:
 - 1. Support direct connection of single-phase or 3-phase low-voltage circuits up to 480 V line-to-line.
 - 2. Provide current inputs that support $\times/0.33$ V and $\times/1.0$ V low-voltage current transformers (LVCT) or Rogowski coil-type sensors.
 - 3. Current Range: Configurable, capable of monitoring circuits up to 5,000 A.
- E. Security:
 - 1. Provide anti-tamper security features to ensure integrity of measurements.
 - 2. Provide additional safety barrier.
 - 3. Provide password-protection to prevent tampering from front panel.
- F. Measured and Calculated Metering Parameters:
 - 1. Support up to four tariffs for accumulation of real energy controlled by internal clock, digital input, or communications.
 - 2. Support real energy (kWh) four-quadrant, reactive energy (kVARh) four-quadrant, active power (kW), reactive power (kVAR), current per phase (I), voltage per phase (V), power factor (PF), frequency (F), overload alarm, and hour counter.
 - 3. Support reading of measurements directly from energy meter display without multipliers.
 - 4. Demand Measurements:
 - a. Provide fixed block or sliding block demand modes with selectable interval for measurement of total active, reactive, and apparent power demand; accessible through front panel or communications.
 - b. Measure current demand per each phase, neutral, and average; available through communications.
 - c. Measure peak demand for demand parameters, maintained in nonvolatile memory with date and time of peak since last reset; accessible through front panel or communications.
 - d. Support reset of demand parameters through front panel or communications.
- G. Measurement Accuracy:
 - 1. Designed to meet 0.5 percent accuracy for real energy and real power in accordance with ANSI C12.20 and IEC 62053-22.
 - 2. Annual recalibration not required to maintain accuracy.
- H. Inputs/Outputs:
 - 1. Provide one digital input configurable for tariff control or WAGES input.
 - 2. Provide one digital output configurable for kWh pulse or kW overload alarm.
- I. Communications:
 - 1. Provide onboard RS485 data port using Modbus (RTU) or BacNet MS/TP protocol for multipoint communications.
 - 2. Provide removable connectors for communication wiring.
- J. Products:
 - 1. Schneider Electric; PowerLogic IEM3000 series.

2.05 MULTI-METER UNIT CABINETS

- A. Factory-assembled enclosure listed and labeled as complying with UL 508A, including cabinet, energy submeters, and communications devices.
- B. Construction: Steel; lockable with provisions for security seal.
- C. UL 50E Rating: Type 1.
- D. Available for configurations of up to 24 energy submeters, readable external to cabinet without opening door.
- E. Provide single set of incoming terminals with fuses for connecting voltage metering leads.

- F. Provide separate control power and voltage-sensing power from main set of incoming terminals for distribution to each meter.
- G. Provide finger-safe terminals.
- H. Provide color-coded and labeled wiring to connect submeters to control and voltage-sensing power.
- I. Provide terminal blocks for incoming and outgoing communication circuit connections with common, single-loop daisy chain for communications wiring connections to energy submeters; arrange to minimize interference from power wiring.
- J. Provide Modbus TCP Ethernet factory-installed and wired communications interface.
- K. Products:
 - 1. Schneider Electric; PowerLogic MMU Series multi-meter unit cabinet for iEM3000 series energy meters.

2.06 ELECTRICAL POWER MANAGEMENT SYSTEM CAPABILITIES

- A. Provide communications connectivity and functionality to support electrical power management system (EPMS), including but not limited to:
 - 1. Communications connectivity via Ethernet network and protocols of EPMS and related equipment, either through communications gateway or integral interface.
 - 2. Compliance with recognized cybersecurity requirements.
 - 3. Remote EPMS capability for equipment configuration, electrical power monitoring, power quality monitoring, compliance, and correction; alarm monitoring with event log.
 - 4. Breaker aging modeling for electronic trip circuit breakers.
 - 5. Continuous thermal monitoring capabilities, including alarming, notification, and visualization.
- B. Provide factory-tested native software compatibility, including the following:
 - 1. Capability for pre-engineered, interactive graphical display screens to view and analyze real-time device data.
 - 2. Pre-mapping of registers to standard measurement names without need for additional configuration or internal device registers.
 - 3. Automatic collection and logging of device data by EPMS software without additional configuration.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine equipment exterior and interior for damage, including but not limited to, structure, moisture, and mildew.
- B. Examine for conditions detrimental to completion of work.

3.02 INSTALLATION

- A. Install equipment in accordance with manufacturer's written instructions.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 45 16 - Field Quality Control Procedures for City of Madison additional requirements.
- B. Manufacturer Services: Provide services of manufacturer's field representative to perform functional testing, commissioning, and first parameter adjusting.
 - 1. Test and adjust controls and safeties.
 - 2. Replace damaged or malfunctioning equipment and report discrepancies or installation issues.

3.04 PROTECTION

- A. Protect installed meters from subsequent construction operations.

END OF SECTION

SECTION 26 27 13.16
POWER QUALITY METERS - SCHNEIDER ELECTRIC POWERLOGIC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Power quality meters.
- B. Advanced power quality meters.
- C. Metering cabinets.

1.02 RELATED REQUIREMENTS

- A. Section 26 09 13.13 - Electrical Power Management System - Schneider Electric Square D EcoStruxure PME.

1.03 ABBREVIATIONS AND ACRONYMS

- A. EPMS: Electrical power management system.
- B. PQ: Power quality.
- C. PTP: Precision time protocol.

1.04 REFERENCE STANDARDS

- A. 47 CFR 15 - Radio Frequency Devices current edition.
- B. ANSI C12.20 - American National Standard for Electricity Meters - 0.1, 0.2, and 0.5 Accuracy Classes 2018, with Errata.
- C. CENELEC EN 50160 - Voltage Characteristics of Electricity Supplied by Public Electricity Networks 2022.
- D. IEC 61000-4-7 - Electromagnetic Compatibility (EMC) – Part 4-7: Testing and Measurement Techniques – General Guide on Harmonics and Interharmonics Measurements and Instrumentation, for Power Supply Systems and Equipment Connected Thereto 2002, with Amendment (2008).
- E. IEC 61000-4-15 - Electromagnetic Compatibility (EMC) – Part 4-15: Testing and Measurement Techniques – Flickermeter – Functional and Design Specifications 2010.
- F. IEC 61000-4-30 - Electromagnetic Compatibility (EMC) - Part 4-30: Testing and Measurement Techniques - Power Quality Measurement Methods 2015, with Amendments (2021).
- G. IEC 61000-6-5 - Electromagnetic Compatibility (EMC) – Part 6-5: Generic Standards – Immunity for Equipment Used in Power Station and Substation Environment 2015 (Corrigendum 2017).
- H. IEC 61326-1 - Electrical Equipment for Measurement, Control and Laboratory Use – EMC Requirements – Part 1: General Requirements 2020.
- I. IEC 61557-12 - Electrical Safety in Low Voltage Distribution Systems Up to 1 000 V AC and 1 500 V DC - Equipment for Testing, Measuring or Monitoring of Protective Measures - Part 12: Power Metering and Monitoring Devices (PMD) 2018 (Corrigendum 2022).
- J. IEC 61850 (SET) - Communication Networks and Systems for Power Utility Automation 2022.
- K. IEC 62053-22 - Electricity Metering Equipment - Particular Requirements - Part 22: Static Meters for AC Active Energy (Classes 0,1S,0,2S and 0,5S) 2020.
- L. IEC 62586-1 - Power Quality Measurement in Power Supply Systems – Part 1: Power Quality Instruments (PQI) 2017.
- M. IEC 62586-2 - Power Quality Measurement in Power Supply Systems – Part 2: Functional Tests and Uncertainty Requirements 2017, with Amendment (2021).
- N. IEEE 519 - IEEE Standard for Harmonic Control in Electric Power Systems 2022.

- O. ISO 9001 - Quality Management Systems — Requirements 2015.
- P. ISO 14001 - Environmental Management Systems — Requirements with Guidance for Use 2015.
- Q. ISO 50001 - Energy Management Systems – Requirements with Guidance for Use 2018.
- R. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- S. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.
- T. UL 61010-1 - Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Provide sufficient information to determine compliance with Contract Documents. Identify submittal data with specific equipment tags and/or service descriptions to which they pertain. Identify specific model numbers, options, and features of equipment proposed.
- C. Indicate deviations from Contract Documents with reference to corresponding drawing or specification number and written justification for deviation.
- D. Product Data: Provide manufacturer's standard catalog pages and data sheets for electricity metering systems and associated components and accessories. Include ratings, configurations, standard wiring diagrams, dimensions, service condition requirements, and installed features.
- E. Shop Drawings: Include system interconnection schematic diagrams showing factory and field connections.
- F. Manufacturer's qualification statement.
- G. Operation and Maintenance Data:
 - 1. Provide detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
 - a. Include manufacturer, supplier, support, and repair center contact information.
 - b. Include manufacturer's standard operation and maintenance data assembled for each size and type of equipment furnished.
 - c. Include contact information for parts stocking location closest to Owner.
 - d. Identify critical spare parts associated with long lead times and/or those critical to unit operation.
 - e. Identify maintenance spare parts required to regularly perform scheduled equipment maintenance including, but not limited to, consumable parts required to be exchanged during scheduled maintenance periods.
- H. Executed warranty.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
 - 1. See Section 01 60 00 - Product Requirements for additional provisions.

1.06 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. NFPA 70.
 - 2. Requirements of local authorities having jurisdiction.
 - 3. Applicable local codes.
- B. Manufacturer Qualifications:
 - 1. Firm engaged in manufacture of specified products of types and sizes required, and whose products have been in satisfactory use in similar service for minimum of 10 years.

2. Certified in accordance with ISO 9001 with applicable quality assurance system regularly reviewed and audited by third-party registrar. Develop and control manufacturing, inspection, and testing procedures under guidelines of quality assurance system.
3. Service, repair, and technical support services available 24 hours per day, 7 days per week from manufacturer or their representative.
4. Certified in accordance with ISO 14001, with product environmental profiles (PEPs) for specified products.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Prior to delivery to project site, verify suitable storage space is available to store materials in well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres.
- B. Protect materials during delivery and storage and maintain within manufacturer's written storage requirements. At minimum, store indoors in clean, dry space with uniform temperature to prevent condensation and protect electronics from potential damage from electrical and magnetic energy.
- C. Deliver materials to project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and equipment tag number or service name as identified in Contract Documents.
- D. Inspect products and report concealed damage or violation of delivery, storage, and handling requirements to Engineer.

1.08 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

- A. See Section 01 77 00 - Closeout Submittals for City of Madison additional warranty requirements.
- B. Manufacturer Warranty: Provide manufacturer warranty for defects in material and workmanship. Complete forms in Owner's name and register with manufacturer.
 1. Power Quality Meters: 5 years from date of invoice.
 2. Advanced Power Quality Meters: 5 years from date of invoice.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Schneider Electric; PowerLogic; www.se.com/#sle.
- B. Source Limitations: Furnish products produced by same manufacturer as other electrical distribution equipment for project and obtained from single supplier.

2.02 GENERAL REQUIREMENTS

- A. List as complying with UL 61010-1.
- B. Certified for use in energy management systems in accordance with ISO 50001.
- C. Electromagnetic Compatibility:
 1. Comply with IEC 61000-6-5 and IEC 61326-1.
 2. Comply with FCC requirements of 47 CFR 15, Class B.
- D. Electrical Power Management System Capabilities:
 1. Provide communications connectivity and functionality to support electrical power management system (EPMS), including but not limited to:
 - a. Communications connectivity via Ethernet network and protocols of EPMS and related equipment, either through communications gateway or integral interface.
 - b. Compliance with recognized cybersecurity requirements.

- c. Remote EPMS capability for equipment configuration, electrical power monitoring, power quality monitoring, compliance, and correction; alarm monitoring with event log.
- 2. Provide factory-tested native software compatibility, including the following:
 - a. Capability for pre-engineered, interactive graphical display screens to view and analyze real-time device data.
 - b. Pre-mapping of registers to standard measurement names without need for additional configuration or internal device registers.
 - c. Automatic collection and logging of device data by EPMS software without additional configuration.

2.03 POWER QUALITY METERS

- A. Capable of monitoring for network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting.
- B. Voltage and Current Inputs:
 - 1. Support direct connection of low-voltage circuits up to 600 VAC without requiring voltage (potential) transformers.
 - 2. Provide four metered 5 A nominal current inputs for 3-phase measurement plus neutral; control power voltage range of 90-415 VAC/120-300 VDC or 20-60 VDC.
- C. Measured and Calculated Metering Parameters: Support full range of 3-phase voltage, current, power, and energy measurements, total harmonic distortion (THD), and individual current/voltage harmonics readings.
- D. Measurement Accuracy:
 - 1. ANSI C12.20; Class 0.2, current classes 2 and 10.
 - 2. IEC 62053-22; Class 0.2S.
 - 3. IEC 61557-12.
- E. High-Visibility Color Graphical Display: User-programmable to display up to six parameters per screen.
- F. Input/Outputs:
 - 1. Provide integrated I/O with minimum of three digital inputs and one digital output for equipment status/position monitoring and equipment control/interface.
 - 2. I/O Modules:
 - a. Support addition of up to four field-installable I/O modules.
 - b. Digital I/O Modules: Provide six digital status/counter inputs and two Form C relay outputs rated at 250 V, 8 A.
 - c. Analog I/O Modules: Provide four inputs configurable for 4-20 mA or 0-30 V ranges, and two outputs configurable for 4-20 mA or 0-10 V ranges.
- G. Communications:
 - 1. Provide multi-port Ethernet and serial communications with minimum of two Ethernet ports and one RS485 serial port.
 - 2. Support IPv4 and IPv6.
 - 3. Support email on alarm, onboard web server, HTTPS, SNMP network management, and PTP/NTP time synchronization.
 - 4. Provide Ethernet-to-serial RS-485 gateway function.
 - 5. Communication Protocols: Support Modbus, DNP3, IEC 61850, ION, Secure ION, MV-90.
- H. Cybersecurity:
 - 1. Support independent enable/disable of communication ports, enable/disable of communication protocols per communications port, and assignment of TCP/IP port numbers per communications protocol.

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2. Support secure protocols including HTTPS in accordance with Transport Layer Security Protocol (TLS) 1.2.
 3. Provide security log to capture security-related events including log-in/log-out (successful or failed), configuration changes, and resets identifying date/time of event and user name of requestor.
 4. Support Syslog protocol to deliver security events to network management server.
- I. Power Quality Analysis and Compliance Monitoring:
1. Provide specified capabilities without requiring separate software.
 2. Display statistical indicators of power quality on front display.
 - a. Include voltage dips/swells, harmonics, and frequency in accordance with CENELEC EN 50160 (for PM83XX and PM82XX models only); provide indication of pass/fail in web interface.
 - b. Concurrently with CENELEC EN 50160 power quality analysis, include total voltage/current harmonic distortion and total voltage/current demand distortion in accordance with IEEE 519 (PM83XX and PM82XX models only); provide indication of pass/fail in web interface.
 3. Certified by third-party laboratory as complying with IEC 61000-4-30, Class 'S' and IEC 62586-2 (PM82XX models only).
 4. Certified by third-party laboratory as complying with IEC 61000-4-30, Class 'S' and IEC 62586-2 (PM82XX models only).
 5. Provide low-pass anti-aliasing signal filters complying with IEC 61000-4-7.
- J. Fault Recording and Waveform Capture:
1. Support up to 225 COMTRADE disturbance capture files for waveforms available via FTP; provide client notification of new captures through RDRE logical node in accordance with IEC 61850 (SET).
 2. Capable of viewing waveforms directly on meter's webpages.
- K. Onboard Logging:
1. Provide nonvolatile timestamps at one-millisecond resolution with onboard logging of input/output (I/O) conditions, minimum/maximum values, energy and demand, maintenance data, alarms, measured parameters, and waveforms.
 2. Provide trending and short-term forecasting of energy and demand.
- L. Alarming:
1. Provide custom alarming with timestamping.
 2. Capable of learning setpoint limits based on system behavior.
 3. Support minimum of 65 setpoint-driven alarms evaluated once per second or once every 1/2 cycle.
 4. Support combining alarms using Boolean logic.
- M. Disturbance Detection (PM83XX and PM82XX models only):
1. Provide high-speed sag/swell detection of voltage disturbances on cycle-by-cycle basis, providing duration of disturbance, minimum, maximum, and average value of voltage for each phase during disturbance.
 2. Determine location of disturbance by identifying direction of disturbance relative to meter; record disturbance direction in event log with timestamp and confidence level indicating level of certainty.
- N. Programming Capability:
1. Support graphical flexible programmable modules that access metered and input data which can be arbitrarily linked together to create application functionality, e.g., totalizations, efficiency measurements, control functions, load shedding, demand response, power factor correction, and compliance monitoring.
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2. Capable of deriving values for combinations of measured or calculated parameters using arithmetic, trigonometric, and logic functions.

O. Products:

1. Schneider Electric; PowerLogic PM8000 series.

2.04 ADVANCED POWER QUALITY METERS

- A. Capable of monitoring for network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting.
- B. Voltage Inputs:
1. Provide inputs for minimum of four phases, neutral, and ground.
 2. Support direct connection of low-voltage circuits up to 600 V (UL) or 690 V (IEC) without requiring voltage (potential) transformers.
 3. Support connection of medium- and high-voltage circuits through voltage (potential) transformers with user-definable primary and secondary transformer ratios.
- C. Current Sensor Inputs:
1. Provide minimum of five inputs.
 2. Support nominal input currents of 1 A and 5 A, and low-power inputs up to 5 V (for ION93XXX models only).
- D. Control Power: 90-480 VAC/110-480 VDC.
- E. Measured and Calculated Metering Parameters: Support four-quadrant metering, full range of 3-phase voltage, current, power, and energy measurements, percentage unbalance, power factor (true and displacement, per phase and three-phase), demand (minimum/maximum, present demand interval, running average demand, and predicted demand), total harmonic distortion (THD), and individual current/voltage harmonics readings.
- F. Measurement Accuracy:
1. ANSI C12.20; Class 0.1, current classes 2, 10, and 20.
 2. IEC 62053-22; Class 0.1S.
 3. IEC 61557-12.
- G. High-Visibility Color Graphical Display:
1. User-programmable to display up to 20 parameters per screen.
 2. Capable of displaying graphical metering data including spectral components, phasor diagrams, and trending charts.
 3. Capable of displaying harmonics content (THD, K-factor, crest-factor) in histogram format.
 4. User Interface: Provide 3.8-inch (96 by 96 mm) graphical color display with push-button control.
- H. Inputs/Outputs:
1. Provide integrated I/O with minimum of eight digital inputs, two digital outputs, and two relay outputs for equipment status/position monitoring and equipment control/interface.
 2. Digital (pulse) output operation provides kWh/kVARh total/imported/exported energy consumption.
 3. I/O Modules:
 - a. Support addition of up to four field-installable I/O modules.
 - b. Digital I/O Modules: Provide six digital status/counter inputs and two Form C relay outputs rated at 250 V, 8 A.
 - c. Analog I/O Modules: Provide four inputs configurable for 4-20 mA or 0-30 V ranges and two outputs configurable for 4-20 mA or 0-10 V ranges.
- I. Communications:
1. Provide multi-port Ethernet and serial communications with minimum of two Ethernet ports and two RS485 serial ports.

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2. Support IPv4 and IPv6 with DHCP IP address assignment.
 3. Support email on alarm, email interval energy data, customizable web server, SNMP network management with traps, and PTP/NTP time synchronization.
 4. Provide Ethernet-to-serial RS-485 gateway function.
 5. Communication Protocols: Support Modbus, DNP3, and IEC 61850 (SET).
 6. Capable of self-identification on Ethernet network without device configuration or user interaction.
- J. Cybersecurity:
1. Support independent enable/disable of communication ports, enable/disable of communication protocols per communications port, and assignment of TCP/IP port numbers per communications protocol.
 2. Support secure protocols including HTTPS in accordance with Transport Layer Security Protocol (TLS) 1.2.
 3. Provide security log to capture security-related events including log-in/log-out (successful or failed), configuration changes, and resets identifying date/time of event and user name of requestor.
 4. Support Syslog protocol to deliver security events to network management server.
 5. Provide trusted platform module (TPM).
- K. Onboard Logging:
1. Provide nonvolatile timestamps with onboard logging of input/output (I/O) conditions, minimum/maximum values, energy and demand, maintenance data, alarms, and measured parameters; trending and short-term forecasting of energy and demand.
 2. Support recording of meter parameters with capability to trigger multiple recordings in continuous succession; triggered manually or through internal event conditions, including periodic timers or setpoint activity by learning setpoint limits based on system behavior.
 3. Support user-defined recording intervals down to 1/2 cycle.
 4. Programmable number of records (depth) and overflow conditions (stop-when-full or circular), limited only by available memory.
- L. Onboard Web Server:
1. Provide access to real-time values, power quality information, and basic meter configuration through web browser.
 2. Waveform Viewing: Provide visualization of voltage and current phases of captured waveforms concurrently; support waveform selection, voltage/current phase selection, zooming in/out, panning with select zoom, saving, and printing.
 3. Provide customizable web interface with support for user-defined web views.
- M. Alarming:
1. Support setpoint-driven alarming.
 2. Support generation of email notification upon alarm condition.
 3. Timestamp Resolution: One millisecond.
 4. Support consecutive high-speed triggers for alarms and waveform recording, triggering on cycle-by-cycle basis with no "dead" time between events (i.e., no requirement for re-arming delay time between events).
 5. Operate relays or initiate data logging captures on alarm conditions.
 6. Control digital output relays in AND/OR configuration using pulse-mode or latch-mode operation for control and alarm purposes.
 7. Combine logical combination of available setpoint conditions to control internal or external function/event.
- N. Event Log:
1. Support minimum of 500 events, programmable up to maximum of 20,000 events.
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2. For each event, record date/time, cause/effect, and priority.
 3. Timestamp Resolution: One millisecond.
 4. Record events relating to setpoint activity, relay operation, configuration, and self-diagnostics.
 5. Event Recording Response Time: 1/2 cycle (8.3 milliseconds at 60 Hz) for high-speed events, 1 second for other events.
 6. Capable of receiving time synchronization signals to synchronize timestamps between devices on same communications network within plus/minus one millisecond; precision time synchronization methods include GPS clock via RS485 serial port, IRIG-B (unmodulated) via digital input, and precision time protocol (PTP) via Ethernet.
- O. Power Quality Analysis and Compliance Monitoring:
1. Provide specified capabilities without requiring separate software.
 2. Comply with IEC 62586-1, PQI-A.
 3. Display statistical indicators of power quality on front display.
 - a. Include voltage dips/swells, harmonics, frequency, rapid voltage change, and mains signaling in accordance with BS EN 50160; provide indication of pass/fail in web interface.
 - b. Concurrently with BS EN 50160 power quality analysis, include total voltage/current harmonic distortion and total voltage/current demand distortion in accordance with IEEE 519; provide indication of pass/fail in web interface.
 4. Compare power quality parameters (present, average, or calculated values) with absolute or relative setpoint; when setpoint is exceeded, alert via email/pager or enable control via local interface to power quality mitigation equipment/control systems through relays and analog/digital outputs.
 5. Certified by third-party laboratory as complying with IEC 61000-4-30 and IEC 61000-4-15 (flicker) in accordance with IEC 62586-2.
 6. Provide low-pass, anti-aliasing signal filters complying with IEC 61000-4-7.
- P. Fault Recording and Waveform Capture:
1. Simultaneously capture voltage and current channels for sub-cycle disturbance, transients, multi-cycle sags, swells, and outages in quick succession, without dead time between recordings.
 2. Waveform Recording Rate: 1,024 samples per cycle with minimum of 17-microsecond transient capture (60 Hz).
 3. Waveform Recording Length: Capable of recording 60 cycles with 30 cycles prior to fault at 1,024 samples per cycle minimum.
 4. Support up to 225 COMTRADE disturbance capture files for waveforms available via FTP; provide client notification of new captures through RDRE logical node in accordance with IEC 61850 (SET).
 5. Capable of recording over one minute of 1-cycle RMS values every 1/2 cycle for voltage, current, frequency, power, power factor, and unbalance based on power system event; record 30 seconds of 1-cycle RMS values prior to event trigger.
- Q. High-Speed Voltage Sag/Swell Detection:
1. Provide high-speed detection of voltage sag/swell disturbances on cycle-by-cycle basis; record duration of disturbance, minimum, maximum, and average value of voltage for each phase during disturbance.
 2. Detect disturbances less than one cycle in duration.
 3. Determine location of disturbance by identifying direction of disturbance relative to meter; record disturbance direction in event log with timestamp and confidence level indicating level of certainty.
- R. Programming Capability:
-

1. Support graphical flexible programmable modules with access to metered and input data that can be arbitrarily linked together to create application functionality, e.g., totalizations, efficiency measurements, load aggregation, control functions, load shedding, demand response, power factor correction, and compliance monitoring.
2. Capable of deriving values for combinations of measured or calculated parameters using arithmetic, trigonometric, logic, thermocouple linearization, and temperature conversion functions.
3. Capable of reading data from networked Modbus devices for logging, exporting, aggregation, totalization, display visualization, web visualization, or user-defined functions.

S. Products:

1. Schneider Electric; PowerLogic ION9000 series.

2.05 METERING CABINETS

- A. Construction: Steel, with factory-supplied knockouts.
- B. UL 50E Rating, Unless Otherwise Indicated:
 1. Indoor Clean, Dry Locations: Type 1.
 2. Outdoor Locations: Type 3R.
- C. Lockable, with provisions for security seal.
- D. Provide single set of incoming terminals for connecting voltage metering leads.
- E. Provide separate control power and voltage-sensing power for distribution to each meter from main set of incoming terminals.
- F. Support power systems up to and including 480 V without requiring external control power transformers.
- G. Provide standard wiring harnesses for internal meter control power and voltage-sensing connections; support daisy-chaining of voltage connections from meter to meter on each row; provide finger-safe terminals for wiring harness connections at meter.
- H. Provide common daisy chain for communications wiring, with single loop for meters connected to circuit and each end terminated in common location; arrange to minimize interference from power wiring.
- I. Except for meters compatible with low-voltage current transducers, provide shorting terminal blocks to connect current transformer leads from field to ordered meters with factory-installed wiring harness to connect CT circuit from shorting block to meter.
- J. Support field installation of meters without requiring cutting or splicing of voltage/communication wiring harnesses.
- K. Provide terminal blocks for incoming and outgoing communications circuit connections.
- L. Products:
 1. Schneider Electric; Square D PowerLogic Metering Cabinet.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine equipment exterior and interior for damage, including but not limited to, structure, moisture, and mildew.
- B. Examine for conditions detrimental to completion of work.

3.02 INSTALLATION

- A. Install equipment in accordance with manufacturer's written instructions.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 45 16 - Field Quality Control Procedures for City of Madison additional requirements.
- B. Manufacturer Services: Provide services of manufacturer's field representative to perform functional testing, commissioning, and first parameter adjusting.
 - 1. Test and adjust controls and safeties.
 - 2. Replace damaged or malfunctioning equipment and report discrepancies or installation issues.

3.04 PROTECTION

- A. Protect installed meters from subsequent construction operations.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Wall switches.
- B. Wall dimmers.
- C. Fan speed controllers.
- D. Receptacles.
- E. Wall plates.
- F. Floor box service fittings.
- G. Poke-through assemblies.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 33.16 - Boxes for Electrical Systems.
- C. Section 26 05 33.23 - Surface Raceways for Electrical Systems: Surface raceway systems, including multioutlet assemblies.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 05 83 - Wiring Connections: Cords and plugs for equipment.
- F. Section 26 09 23 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors, in-wall time switches, and in-wall interval timers.
- G. Section 27 10 00-Structured Cabling: Voice and data jacks.

1.03 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for 2014h, with Amendments (2017).
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification) 2014g, with Amendment (2017).
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2016.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices 1999 (Reaffirmed 2020).
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications 2021.
- 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 1310 - Class 2 Power Units Current Edition, Including All Revisions.
- M. UL 1449 - Standard for Surge Protective Devices Current Edition, Including All Revisions.
- N. UL 1472 - Solid-State Dimming Controls Current Edition, Including All Revisions.
- O. UL 1917 - Solid-State Fan Speed Controls Current Edition, Including All Revisions.

1.04 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. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
 - 6. Notify Architect 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.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
 - 1. Surge Protection Receptacles: Include surge current rating, voltage protection rating (VPR) for each protection mode, and diagnostics information.
- C. Samples: One for each type and color of device and wall plate specified.
- D. Certificates for Surge Protection Receptacles: Manufacturer's documentation of listing for compliance with UL 1449.
- 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. Operation and Maintenance Data:
 - 1. Wall Dimmers: Include information on operation and setting of presets.
 - 2. GFCI Receptacles: Include information on status indicators.
 - 3. Surge Protection Receptacles: Include information on status indicators.
- H. Project Record Documents: Record actual installed locations of wiring devices.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.06 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.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS**2.01 WIRING DEVICE APPLICATIONS**

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
- B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
- C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.
- D. Provide tamper resistant receptacles for receptacles installed in dwelling units.
- E. Provide GFCI protection for receptacles installed within 6 feet of sinks.
- F. Provide GFCI protection for receptacles installed in kitchens.
- G. Provide GFCI protection for receptacles serving electric drinking fountains.
- H. Unless noted otherwise, do not use combination switch/receptacle devices.

2.02 WIRING DEVICE FINISHES

- A. Provide wiring device finishes as described below unless otherwise indicated.
- B. Wiring Devices, Unless Otherwise Indicated: White with white nylon wall plate.
- C. Wiring Devices Installed in Finished Spaces: White with white nylon wall plate.
- D. Wiring Devices Installed in Unfinished Spaces: Gray with stainless steel wall plate.
- E. Wiring Devices Installed in Wet or Damp Locations: White with specified weatherproof cover.
- F. Isolated Ground Convenience Receptacles: Orange.
- G. Surge Protection Receptacles: Blue.
- H. Wiring Devices Connected to Emergency Power: Red with red nylon wall plate.

2.03 WALL SWITCHES

- A. Manufacturers:
 - 1. Lutron Electronics Company, Inc; Maestro Series: www.lutron.com/#sle.
 - 2. SensorSwitch: <https://sensorswitch.acuitybrands.com/>
 - 3. Hubbell Incorporated: www.hubbell.com/#sle.
 - 4. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
 - 5. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.
- 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. Plug-in wiring connections not permitted.
- 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.
- D. Lighted Wall Switches: Industrial specification grade, 20 A, 120/277 V with illuminated standard toggle type switch actuator and maintained contacts; illuminated with load off; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.
- E. Pilot Light Wall Switches: Industrial specification grade, 20 A, 120/277 V with red illuminated standard toggle type switch actuator and maintained contacts; illuminated with load on; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

- F. Locking Wall Switches: Industrial specification grade, 20 A, 120/277 V with lever type keyed switch actuator and maintained contacts; switches keyed alike; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.
- G. Momentary Contact Wall Switches: Industrial specification grade, 20 A, 120/277 V with toggle type three position switch actuator and momentary contacts; single pole double throw, off with switch actuator in center position.
- H. Locking Momentary Contact Wall Switches: Industrial specification grade, 20 A, 120/277 V with lever type keyed three position switch actuator and momentary contacts; switches keyed alike; single pole double throw, off with switch actuator in center position.

2.04 WALL DIMMERS

- A. Manufacturers:
 - 1. Lutron Electronics Company, Inc; Maestro Series: www.lutron.com/#sle.
 - 2. SensorSwitch; <https://sensorswitch.acuitybrands.com/>
- B. Wall Dimmers - General Requirements: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.
- C. Control: Slide control type with separate on/off switch.
- D. Power Rating, Unless Otherwise Indicated or Required to Control the Load Indicated on the Drawings:

2.05 FAN SPEED CONTROLLERS

- A. Description: 120 V AC, solid-state, full-range variable speed, slide control type with separate on/off switch, with integral radio frequency interference filtering, fan noise elimination circuitry, power failure preset memory, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1917.
 - 1. Current Rating: 1.5 A unless otherwise indicated or required to control the load indicated on the drawings.

2.06 RECEPTACLES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com/#sle.
 - 2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
 - 3. 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. Isolated Ground Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, with ground contacts isolated from mounting strap; isolated ground triangle mark on device face; single or duplex as indicated on the drawings.
 - 3. Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled 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.
 - 4. Tamper Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.

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5. 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. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.
 4. Tamper Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.
 5. 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.
- E. USB Charging Devices:
1. USB Charging Devices - General Requirements: Listed as complying with UL 1310.
 - a. Charging Capacity - Two-Port Devices: 2.1 A, minimum.
 - b. Charging Capacity - Four-Port Devices: 4.2 A, minimum.
 2. USB Charging/Tamper Resistant Receptacle Combination Devices: Two-port (Type A) USB charging device and receptacle, commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; rectangular decorator style.
- F. Locking Receptacles: Industrial specification grade, configuration as indicated on the drawings.

2.07 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. SensorSwitch: <https://sensorswitch.acuitybrands.com/>
 5. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
 6. Substitutions: See Section 01 60 00 - Product Requirements.
 7. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.
- 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. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.
- E. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.
- F. Weatherproof Covers for Damp Locations: Gasketed, cast aluminum, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed.
-

- G. Weatherproof Covers for Wet 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.

2.08 FLOOR BOX SERVICE FITTINGS

- A. Manufacturers:
1. Legrand North America, Inc: www.legrand.us/#sle.
 2. Thomas & Betts Corporation: www.tnb.com/#sle.
- B. Description: Service fittings compatible with floor boxes provided under Section 26 05 33.16 with components, adapters, and trims required for complete installation.
- C. Flush Floor Service Fittings:
1. Single Service Flush Convenience Receptacles:
 - a. Cover: Rectangular.
 - b. Configuration: One standard convenience duplex receptacle(s) with duplex flap opening(s).
 2. Single Service Flush Communications Outlets:
 - a. Cover: Rectangular.
 - b. Configuration: _____.
 - c. Voice and Data Jacks: As specified in Section 27 10 00.
 3. Single Service Flush Furniture Feed:
 - a. Cover: Rectangular.
 - b. Configuration: One 2-1/8 inch by 3/4 inch combination threaded opening(s).
 4. Dual Service Flush Combination Outlets:
 - a. Cover: Rectangular.
 - b. Configuration:
 - 1) Power: One standard convenience duplex receptacle(s) with duplex flap opening(s).
 - 2) Communications: .
 - 3) Voice and Data Jacks: As specified in Section 27 10 00.
 5. Dual Service Flush Furniture Feed:
 - a. Cover: Rectangular.
 - b. Configuration:
 - 1) Power: One 2-1/8 inch by 3/4 inch combination threaded opening(s).
 - 2) Communications: One 2-1/8 inch by 1 inch combination threaded opening(s).
 6. Accessories:
 - a. Tile Rings: Finish to match covers; configuration as required to accommodate specified covers.
 - b. Carpet Flanges: Finish to match covers; configuration as required to accommodate specified covers.
 7. Products:
 - a. Hubbell Incorporated: www.hubbell.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 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 wall openings are neatly cut and will be completely covered by 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 wiring devices.

- F. Verify that conditions are satisfactory for installation prior to starting work.

3.02 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.

3.03 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 05 33.16 as required for installation of wiring devices provided under this section.
1. Mounting Heights: Unless otherwise indicated, as follows:
 - a. Wall Switches: 48 inches above finished floor.
 - b. Wall Dimmers: 48 inches above finished floor.
 - c. Receptacles: 18 inches above finished floor or 6 inches 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 from edge of door frame. Where locations are indicated otherwise, notify Architect 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 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. For isolated ground receptacles, connect wiring device grounding terminal only to identified branch circuit isolated equipment grounding conductor. Do not connect grounding terminal to outlet box or normal branch circuit equipment grounding conductor.
- I. Unless otherwise indicated, GFCI receptacles may be connected to provide feed-through protection to downstream devices. Label such devices to indicate they are protected by upstream GFCI protection.
- J. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- K. Install wall switches with OFF position down.
- L. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- M. Do not share neutral conductor on branch circuits utilizing wall dimmers.
- N. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- O. 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.

- P. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
- Q. Identify wiring devices in accordance with Section 26 05 53.
- R. Install poke-through closure plugs in each unused core holes to maintain fire rating of floor.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 45 16 - Field Quality Control Procedures for City of Madison additional requirements.
- B. Inspect each wiring device for damage and defects.
- C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.
- D. Test each receptacle to verify operation and proper polarity.
- E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- F. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Architect/Owner.

3.06 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 31 00
PHOTOVOLTAIC SYSTEM PERFORMANCE REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes general performance requirements that apply to installing a solar electric (PV) system for this project
- B. Contractor is the Designer of Record for this system. Contractor is required to provide a Structural PE (Professional Engineer) Stamp for the structural design and an Electrical PE Stamp for the overall system design.
- C. Both the structural and electrical stamps are to be provided from experienced PV designers with at least 5 similar completed projects.
- D. Contractor is required to have experience with at least 5 similar completed PV projects.
- E. Product specifications included in this section are the Basis for Design. Design substitutions shall meet the minimum performance requirements defined in this section. Contractor shall select number of inverters and perform string sizing.
- F. Incentive Paperwork:
 - 1. Contractor to provide support with Owner's application for Focus on Energy incentives.

1.02 RELATED WORK AND REQUIREMENTS

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

1.03 DEFINITIONS

- A. MPPT: Maximum power point tracking.
- B. STC: Standard test conditions, 1000 W/m², 1.5 air mass, and 25°C cell temperature.
- C. NABCEP: North American Board of Certified Energy Practitioners
- D. PTC: PV USA Test Conditions, 1000 W/m², 1.5 air mass, 20°C air temperature, and 1 meter/sec. wind speed.
- E. Voc: Open circuit voltage
- F. Isc: Short circuit current.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Experience: Submit resumes for individuals involved with the design and construction of the PV System. Submit references and summaries of five similar projects that these individuals have completed.
- C. Product Data: For each type of component indicated below. Include rated capacities, operating characteristics, and furnished specialties and accessories. All product data submittals shall be submitted for review by Owner prior to purchasing any materials or equipment.
 - 1. Solar modules
 - 2. Grid tied inverters, including efficiency data.
 - 3. Racking system, including rail, clamps, and brackets.
- D. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. All shop drawings shall be submitted for review by Owner prior to purchasing any materials or equipment.
 - 1. Dimensioned AutoCAD plan drawings of equipment including solar module array, inverters, disconnects, metering, and electrical conduit routing.

2. Provide AutoCAD drafted one-line wiring diagram of solar PV system indicating ratings of all modules and inverters, wire and conduit types and sizes, and disconnects.
- E. Design Calculations
 1. The following design calculations shall be performed by Contractor and submitted for review by Owner prior to purchasing any materials or equipment.
 - a. Electrical calculations, including string sizing, inverter selection, and voltage losses.
 - b. Structural calculations, including rail spans, wind and snow loading, required ballast weights, and roof strength calculations.
- F. Permitting and Agreements
 1. The following permits and agreements shall be prepared by Contractor on behalf of the Owner. All approved permits and agreements shall be submitted for review by Owner prior to purchasing any materials or equipment.
 - a. Utility interconnection agreement
 - b. Building permit
 - c. Electrical permit
- G. As built drawings:
 1. Dimensioned AutoCAD plan drawings of equipment including solar module array, inverters, disconnects, metering, and electrical routing.
 2. Provide AutoCAD drafted one-line diagram of solar PV system indicating ratings of all modules and inverters, wire and conduit types and sizes, and disconnects.
- H. Field quality-control test reports.
 1. Include voltages and power output for each string. Measure and record solar intensity during testing. Include time, date, and weather conditions of test.
- I. Warranty: Copies of all manufacturer's and installer's warranties.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.
 2. Installer must have PV Installer certification through NABCEP or applying for certification.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70 and all applicable state and local codes

1.06 COORDINATION

- A. Coordinate metering and interconnection agreement with electric utility. Contractor shall pay all interconnection fees including the application review fee, engineering review fee, and distribution system study fee. Contractor shall submit all required forms to utility.
- B. Coordinate all work affecting building's roof with roofing manufacturer to ensure the roof's warranty is maintained.

1.07 WARRANTY

- A. Installer must provide a two year installation warranty covering any defects of the installation.
- B. Module Warranty Period:
 1. 5 years workmanship warranty.
 2. Module warranty provided by manufacturer, not through a third party
 3. 1 year 97% power output warranty, then:
 - a. 10 year 90% linear power output warranty.
 - b. 25 year 80% linear power output warranty.

- C. Inverter Warranty Period: 15 year warranty.
- D. Racking Warranty Period: 10 year warranty.

PART 2 - PRODUCTS

2.01 SOLAR MODULES

- A. Preapproved Manufacturers: Subject to compliance with performance requirements, manufacturers offering products that may be incorporated into the Work include:
 - 1. Canadian Solar
 - 2. Hanwha Q-cells
 - 3. Heliene
 - 4. REC Group
 - 5. Trina Solar.
 - 6. First Solar
 - 7. Mission Solar
 - 8. SilFab
 - 9. CrossRoads Solar
- B. If an alternate product is proposed, bid is to document how the proposed solution is more cost effective to the owner. Follow substitution request procedure per 01 25 13.
- C. Capacities and Characteristics:
 - 1. All modules shall be from a single manufacturer.
 - 2. Power Output Ratings: STC rated power of at least 400 watts if 60 cell or 120 half-cell and at least 460 watts if 72 cell or 144 half-cell.
 - 3. DC Array size of at least 124 KW.
 - 4. Power tolerance: -0%/+5%
 - 5. Nameplates: To identify electrical characteristics, manufacturer's name and address, and model and serial number of component.
 - 6. Module efficiency: minimum 19.50% at STC
 - 7. 60, 72 (or 120, 144 half cells)
- D. Materials and construction
 - 1. Monocrystalline or Polycrystalline
 - 2. Monofacial
 - 3. Junction box with bypass diodes.
 - 4. Staubli MC4 connectors.
 - 5. Anodized aluminum frame with drainage holes and grounding holes.
 - 6. Operating temperature range of -40°C to +85°C.
 - 7. Withstand 1" diameter hail at 50 mph without damage.
 - 8. Load rated at 5400 Pa (113 psf) when used with two rail system.

2.02 INVERTERS

- A. Preapproved Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include:
 - 1. Solar Edge (Basis of Design)
 - 2. Fronius
 - 3. SMA
- B. If an alternate product is proposed, bid is to document how the proposed solution is more cost effective to the owner. Follow substitution request procedure per 01 25 13.
- C. Standards
 - 1. IEEE 1547
 - 2. UL 1741 – anti-islanding.

D. Electrical characteristics

1. AC kW rating: Minimum DC-to-AC ratio of 1.2
2. Output voltage: 208 VAC 3 phase
3. Frequency: 60 Hz sine wave
4. Input voltage: Coordinated with solar array.
5. Max Voc: Coordinated with solar array.
6. Max DC current: Coordinated with solar array.
7. Startup voltage: Coordinated with solar array.
8. Output power factor: Unity
9. DC to AC conversion efficiency:
 - a. % CEC rated efficiency
10. AC and DC rapid shutdown compliant with NEC 2017

E. Features

1. Transformerless design.
2. Forward facing DC disconnect
3. DC side ground fault protection.
4. Inverter must limit power output to nameplate value. If connected to an array capable of producing more than the inverter's capacity, the inverter must limit the power without damage.
5. Maximum power point tracking over the range of voltages of the array, at the ambient temperatures of the site.
6. User navigable display.
7. LED status lights on enclosure.
8. Communication port for diagnostics and communication port for communication with multiple inverters and internet interface device.
9. NEMA 3R enclosure

2.03 PV WIRING

- A. Type PV-WIRE, #10AWG, from array to combiner box, and where used as a jumper for connection between modules.
- B. UV-Stabilized Cable Ties:
 1. Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
 2. Minimum Width: 3/16 inch (5 mm).
 3. Tensile Strength at 73 °F (23 °C), According to ASTM D 638: 12,000 psi (82.7 MPa).
 4. Temperature Range: -40 to +185 °F (-40 to +85 °C).
 5. Color: Black.
- C. Ampacity of PV source circuits shall be a minimum of 156% of the sum of parallel strings short circuit currents.
 1. Shall be sized to limit voltage drop to 1.5% from array to inverter during full production at MPPT voltage at maximum ambient temperature.
 2. Shall be in metallic conduit from combiner box to inverter.

2.04 RACKING & ROOF ATTACHMENT & ROOF PENETRATIONS

- A. Preapproved Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include:
 1. Products for ballasted systems on flat roofs:
 - a. Unirac RM10
 - b. Ecolibrium Solar Ecofoot

2.05 INTERNET BASED MONITORING

- A. Provide standard package from inverter manufacturer and connect to the City Network. Coordinate with Owner. Contractor is required to test monitoring to confirm it is functioning.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in of electrical connections. Verify actual locations of connections before module installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 ARRAY REQUIREMENTS

- A. Install modules on racking designed for solar (PV) modules.
- B. Structural Performance: Installation shall withstand all local wind and snow loads, and all local building department requirements.
- C. Slip sheet is to be used between ballasted racking and roof membrane
- D. All fastening hardware must be stainless steel.
- E. All materials must be metallurgically compatible where different materials are in contact with each other.
- F. Roof penetrations shall be made watertight using methods that are standard to the roofing industry, are approved by the roofing manufacturer, and that protect the warranty of the roof.
- G. The modules shall be connected in arrays with the following characteristics:
 - 1. The modules shall be installed only in the area outlined on the roof plan.
 - 2. Proposed alternate layout shall be submitted to CPM and approved prior to installation begins.
 - 3. Each array shall be provided with a combiner box.
 - 4. PV module cables may be installed exposed where routed directly behind modules, but all cables shall be installed in a section of conduit where crossing part of the roof not under a module. Conduit running across roof shall be supported on roof using Cooper B-Line Dura-Blok or equivalent. Conduit shall be intermediate metallic conduit.
 - 5. All PV module cables shall be installed in a neat and workmanship like manner. Excess wire shall be coiled and bundled neatly and supported securely in an area where they are not subject to environmental degradation, such as from wind, sun, and animals. Attach PV module cables to racking with zip-ties listed for use in direct sunlight.
 - 6. Modules shall be connected in series and parallel to match voltage and current ratings of inverter, across all ambient temperatures common to site (-25°C to 40°C).
 - a. Open circuit voltage of array on coldest day of year in full sunlight shall not exceed maximum operating voltage rating of inverter, modules, or any other equipment.
 - b. Open circuit voltage on warmest day of year in morning sunlight conditions (200W/m2 irradiance) shall exceed inverter startup voltage. Voltage under operating MPPT conditions, minus any voltage drop over conductors, shall exceed minimum inverter input voltage.
 - c. Available short circuit current multiplied by 1.25 shall not exceed ratings for the inverter or any modules.
 - d. All series strings of modules shall have same performance characteristics.

3.03 ELECTRICAL INSTALLATION

- A. Ground equipment according to Division 26
 - 1. Size grounding conductors per NEC articles 250 and 690.
 - 2. All conductive equipment enclosures must be grounded.
 - 3. All module frames must be grounded.

- a. The removal of any module shall not interrupt a grounded conductor to another photovoltaic source circuit.
- B. Install wiring, combiner boxes, conduit, disconnects, inverter, web based monitoring hardware, sensors and other equipment according to Division 26.
 - 1. Exception – If Division 26 specifies otherwise, All Solar Electric Conduit material is to be metallic.
- C. Connect wiring according to Division 26.

3.04 IDENTIFICATION

- A. Identify and label system components according to Division 26.
 - 1. Provide a unique label for each inverter, PV output circuit, combiner box, PV Source circuit, and module. Labeling shall match labeling shown on as-built diagram and plan provided by contractor.
- B. Provide all labeling required by NEC article 690, including, but not limited to:
 - 1. Label disconnects capable of being energized from both directions as such.
 - 2. Provide plaque at utility service disconnect per article 690.56B. Field verify exact location.
 - 3. Label each photovoltaic disconnecting means per NEC article 690.53.

3.05 FIELD QUALITY CONTROL

- A. Perform tests and inspections as indicated below and prepare test reports. Correct any deficiencies.
 - 1. Visually inspect all connections.
 - 2. Visually inspect all supports.
 - 3. Measure Voc of each individual string of modules under full sunlight.
 - a. Verify Voc of all strings are balanced.
 - b. Verify measured Voc against calculated Voc for the ambient temperature. Extrapolate Voc to temperatures expected at site, and verify they are within inverters ratings.
 - 4. Measure Isc of each string of modules.
 - 5. Verify correct operation of inverter.
 - 6. Verify correct operation of complete system.
 - 7. Replace any defective modules. Modules shall be replaced at contractor's expense.

3.06 DEMONSTRATION

- A. Simulate power outage by interrupting normal source, and demonstrate that system disconnects from utility.
- B. Provide owner's maintenance personnel with minimum two hour training session and in compliance with Div 1 Training Requirements.
 - 1. Provide training on function of each piece of equipment.
 - 2. Provide training on maintaining the system.
 - 3. Explain means of disconnecting the system, and principals of operation and safety.

END OF SECTION

SECTION 26 43 00 SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surge protective devices for service entrance locations.
- B. Surge protective devices for distribution locations.
- C. Surge protective devices for branch panelboard locations.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 21 00 - Low-Voltage Electrical Service Entrance.
- C. Section 26 24 13 - Switchboards.
- D. Section 26 24 16 - Panelboards.
- E. Section 26 27 26 - Wiring Devices - Lutron: Receptacles with integral surge protection.
- F. Section 27 00 05 - Communications Cabling: Protectors for communications service entrance.

1.03 ABBREVIATIONS AND ACRONYMS

- A. EMI/RFI: Electromagnetic Interference/Radio Frequency Interference.
- B. SPD: Surge Protective Device.

1.04 REFERENCE STANDARDS

- A. MIL-STD-220 - Method of Insertion Loss Measurement 2009c (Validated 2019).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.
- E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 1283 - Standard for Electromagnetic Interference Filters Current Edition, Including All Revisions.
- G. UL 1449 - Standard for Surge Protective Devices Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

1.06 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.
 - 1. SPDs with EMI/RFI filter: Include noise attenuation performance.
- C. Shop Drawings: Include wiring diagrams showing all factory and field connections with wire and circuit breaker/fuse sizes.
- D. Certificates: Manufacturer's documentation of listing for compliance with the following standards:
 - 1. UL 1449.
 - 2. UL 1283 (for Type 2 SPDs).
- E. Field Quality Control Test Reports.

- F. 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.
- G. Operation and Maintenance Data: Include information on status indicators and recommended maintenance procedures and intervals.
- H. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- I. Project Record Documents: Record actual connections and locations of surge protective devices.

1.07 QUALITY ASSURANCE

- A. Comply with 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.

1.08 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in accordance with manufacturer's written instructions.

1.09 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

- A. See Section 01 77 00 - Closeout Submittals for City of Madison additional warranty requirements.
- B. Manufacturer's Warranty: Provide minimum five year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.
- C. Exclude surge protective devices from any clause limiting warranty responsibility for acts of nature, including lightning, stated elsewhere.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Surge Suppression, LLC (SSI), as indicated under product descriptions below; www.surgesuppression.com/#sle.
- B. Field-installed, Externally Mounted Surge Protective Devices - Other Acceptable Manufacturers:
 - 1. ABB/GE: www.geindustrial.com/#sle.
 - 2. Current Technology; a brand of Thomas & Betts Power Solutions: www.tnbpowersolutions.com/#sle.
 - 3. Schneider Electric; Square D Brand Surgelogic Products: www.surgelogic.com/#sle.
- C. Factory-installed, Internally Mounted Surge Protective Devices:
 - 1. Same as manufacturer of equipment containing surge protective device, to provide a complete listed assembly including SPD.
- D. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Source Limitations: Furnish surge protective devices produced by a single manufacturer and obtained from a single supplier.

2.02 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

- A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.
- B. Unless otherwise indicated, provide field-installed, externally-mounted or factory-installed, internally-mounted SPDs.

- C. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.
- D. Protected Modes:
- E. UL 1449 Voltage Protection Ratings (VPRs):
- F. UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.
- G. Enclosure Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:

2.03 SURGE PROTECTIVE DEVICES FOR SERVICE ENTRANCE LOCATIONS

- A. Surge Protective Device - Basis of Design: Surge Suppression, LLC (SSI); Advantage Series; Model SSLA (100 kA/phase, Type 2, I-n = 10 kA); www.surgesuppression.com/#sle.
 - 1. Voltage: As indicated on drawings.
 - 2. Features: Discrete "all-mode" protection (10 modes for 3-phase wye circuits); component-level thermal fusing; internal circuit board-mounted overcurrent fusing; 200 kAIC SCCR; 25 year warranty.
 - 3. Include the following options:
 - a. DIAGNOSTIC OPTIONS----->
 - b. AC10 - Basic internal audible alarm with dry relay contacts.
 - c. C - Form C dry relay contacts.
 - d. C1 - Form C dry relay contacts pre-wired.
 - e. LP - Remote LED indicators in individual NEMA 4X housings.
 - f. S6 - Surge counter with reset button.
 - g. ENCLOSURE AND DISCONNECT SWITCH OPTIONS----->
 - h. M - NEMA 12 steel enclosure.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.
- C. Verify system grounding and bonding is in accordance with Section 26 05 26, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- C. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 26 05 26 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - 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 7.19.1.

- D. Procure services of a qualified manufacturer's representative to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's reports with field quality control submittals.

3.04 CLEANING

- A. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

**SECTION 26 51 00
INTERIOR LIGHTING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. Drivers.
- E. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- B. Section 26 05 33.16 - Conduit for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 09 23 - Lighting Control Devices.
 - 1. Includes automatic controls for lighting including occupancy sensors, outdoor motion sensors, time switches, outdoor photo controls, and daylighting controls.
 - 2. Includes lighting contactors.
- E. Section 26 27 26 - Wiring Devices: Manual wall switches and wall dimmers.
- F. Section 26 56 00 - Exterior Lighting.

1.03 REFERENCE STANDARDS

- A. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code) 1989 (Corrigendum 2019).
- B. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information 2019.
- C. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products 2019.
- D. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources 2021.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- F. NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems 2006.
- G. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts 2023.
- H. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility 2012 (Reaffirmed 2018).
- I. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 924 - Emergency Lighting and Power Equipment Current Edition, Including All Revisions.
- L. UL 1598 - Luminaires Current Edition, Including All Revisions.
- M. UL 1598C - Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits Current Edition, Including All Revisions.
- N. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products Current Edition, Including All Revisions.

1.04 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 of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Shop Drawings:
 - 1. 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.
 - 2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IES LM-63 standard format upon request.
- 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: Instructions for each product including information on replacement parts.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.06 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. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting) and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.08 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

- A. See Section 01 77 00 - Closeout Submittals for City of Madison additional warranty requirements.
- B. Provide three year manufacturer warranty for LED luminaires, including drivers.
- C. Provide five year pro-rata warranty for batteries for emergency lighting units.
- D. Provide ten year pro-rata warranty for batteries for self-powered exit signs.

PART 2 PRODUCTS**2.01 LUMINAIRE TYPES**

- A. Furnish products as indicated in luminaire schedule included on the drawings.
- B. Substitutions: See Section 01 60 00 - Product Requirements except where individual luminaire types are designated with substitutions not permitted.

2.02 LUMINAIRES

- A. Manufacturers:
 - 1. Acuity Brands, Inc: www.acuitybrands.com/#sle.
 - 2. Cooper Lighting, a division of Cooper Industries: www.cooperindustries.com/#sle.
 - 3. Hubbell Lighting, Inc: www.hubbelllighting.com/#sle.
 - 4. Philips Lighting North America Corporation; www.lightingproducts.philips.com/#sle.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Provide products that comply with requirements of NFPA 70.
- C. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- D. Provide products listed, classified, and labeled as suitable for the purpose intended.
- E. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, drivers, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- F. 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.
- G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- H. 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.
- I. 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.
- J. LED Tape Lighting Systems: Provide all power supplies, drivers, cables, connectors, channels, covers, mounting accessories, and interfaces as necessary to complete installation.
 - 1. LED Tape - General Requirements:
 - a. Listed.
 - b. Designed for field cutting in accordance with listing.
 - c. Wet Location Applications: IEC 60529, IP 68 (waterproof) rated.

- 2. White LED Tape:
 - a. Color Rendering Index (CRI): Not less than 90.
- K. Track Lighting Systems: Provide track compatible with specified track heads, with all connectors, power feed fittings, dead ends, hangers and canopies as necessary to complete installation.
- L. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

2.03 EMERGENCY LIGHTING UNITS

- A. Manufacturers:
 - 1. Acuity Brands, Inc: www.acuitybrands.com/#sle.
 - 2. Cooper Lighting, a division of Cooper Industries: www.cooperindustries.com/#sle.
 - 3. Hubbell Lighting, Inc: www.hubbelllighting.com/#sle.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- C. 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.
- D. Battery:
 - 1. Sealed maintenance-free nickel cadmium unless otherwise indicated.
 - 2. Size battery to supply all connected lamps, including emergency remote heads where indicated.
- E. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
- F. Provide low-voltage disconnect to prevent battery damage from deep discharge.
- G. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.
- H. Accessories:
 - 1. Provide compatible accessory mounting brackets where indicated or required to complete installation.
 - 2. Provide compatible accessory high impact polycarbonate vandal shields where indicated.
 - 3. Provide compatible accessory wire guards where indicated.
 - 4. Where indicated, provide emergency remote heads that are compatible with the emergency lighting unit they are connected to and suitable for the installed location.

2.04 EXIT SIGNS

- A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.
 - 1. Number of Faces: Single- or double-face as indicated or as required for installed location.
 - 2. Directional Arrows: As indicated or as required for installed location.
- B. Powered Exit Signs: Internally illuminated with LEDs unless otherwise indicated.
 - 1. Manufacturers:
 - a. Acuity Brands, Inc: www.acuitybrands.com/#sle.
 - b. Cooper Lighting, a division of Cooper Industries: www.cooperindustries.com/#sle.
 - c. Hubbell Lighting, Inc: www.hubbelllighting.com/#sle.
 - d. Philips Lighting North America Corporation; www.lightingproducts.philips.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Self-Powered Exit Signs:

- a. 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.
- b. Battery: Sealed, maintenance-free, nickel cadmium unless otherwise indicated.
- c. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
- d. Provide low-voltage disconnect to prevent battery damage from deep discharge.
- e. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.

2.05 DRIVERS

- A. Manufacturers:
 - 1. General Electric Company/GE Lighting: www.gelighting.com/#sle.
 - 2. Lutron Electronics Company, Inc; www.lutron.com/#sle.
 - 3. OSRAM Sylvania, Inc: www.osram.us/ds/#sle.
 - 4. Philips Lighting North America Corporation; www.usa.lighting.philips.com/#sle.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
 - 6. Manufacturer Limitations: Where possible, for each type of luminaire provide drivers produced by a single manufacturer.
 - 7. Where a specific manufacturer or model is indicated elsewhere in the luminaire schedule or on the drawings, substitutions are not permitted unless explicitly indicated.
- B. Drivers - General Requirements:
 - 1. Provide drivers containing no polychlorinated biphenyls (PCBs).
 - 2. Minimum Efficiency/Efficacy: Provide drivers complying with all current applicable federal and state driver efficiency/efficacy standards.
- C. Dimmable LED Drivers:
 - 1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
 - 2. Control Compatibility: Fully compatible with the dimming controls to be installed.
 - a. Wall Dimmers: See Section 26 27 26.
 - b. Daylighting Controls: See Section 26 09 23.

2.06 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.
- C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.
- D. Fire-Rated Luminaire Enclosures:
 - 1. Provide as required to preserve fire resistance rating of building elements.

PART 3 EXECUTION

3.01 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.

3.02 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.

3.03 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 05 33.16 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 securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting).
- E. Provide required support and attachment in accordance with Section 26 05 29.
- F. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- G. 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 recessed luminaires to ceiling support channels or framing members or to building structure.
 - 4. Secure pendant-mounted luminaires to building structure.
 - 5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
 - 6. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- H. Recessed Luminaires:
 - 1. Install trims tight to mounting surface with no visible light leakage.
 - 2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
 - 3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.
- I. 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 between supports.
 - 4. Install canopies tight to mounting surface.
 - 5. Unless otherwise indicated, support pendants from swivel hangers.
- J. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- K. Install accessories furnished with each luminaire.
- L. Bond products and metal accessories to branch circuit equipment grounding conductor.
- M. Emergency Lighting Units:
 - 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.

2. Install lock-on device on branch circuit breaker serving units.
- N. 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.
 2. Install lock-on device on branch circuit breaker serving units.
- O. Install lamps in each luminaire.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 45 16 - Field Quality Control Procedures for City of Madison additional requirements.
- B. Inspect each product for damage and defects.
- C. Operate each luminaire after installation and connection to verify proper operation.
- D. Test self-powered exit signs and emergency lighting units to verify proper operation upon loss of normal power supply.
- E. Correct wiring deficiencies and repair or replace damaged or defective products.

3.05 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.
- B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.
- C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

3.06 CLEANING

- A. Clean surfaces according to NECA 500 (commercial lighting) and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

- A. See Section 01 77 00 - Closeout Submittals for City of Madison closeout submittals.
- B. See Section 01 79 00 - Demonstration and Training for City of Madison additional requirements.
- C. Just prior to Substantial Completion, replace all lamps that have failed.

3.08 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

**SECTION 26 56 00
EXTERIOR LIGHTING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Exterior luminaires.
- B. Drivers.
- C. Poles and accessories.
- D. Luminaire accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Materials and installation requirements for concrete bases for poles.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 33.16 - Boxes for Electrical Systems.
- E. Section 26 09 23 - Lighting Control Devices.
 - 1. Includes automatic controls for lighting including outdoor motion sensors, time switches, and outdoor photo controls.
- F. Section 26 27 26 - Wiring Devices: Receptacles for installation in poles.
- G. Section 26 51 00 - Interior Lighting.

1.03 REFERENCE STANDARDS

- A. 47 CFR 15 - Radio Frequency Devices current edition.
 - B. AASHTO LTS - Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals 2013, with Editorial Revision (2022).
 - C. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing 2023.
 - D. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code) 1989 (Corrigendum 2019).
 - E. IEEE C2 - National Electrical Safety Code(R) (NESC(R)) 2023.
 - F. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information 2019.
 - G. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products 2019.
 - H. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources 2021.
 - I. IES RP-8 - Recommended Practice: Lighting Roadway and Parking Facilities 2022.
 - J. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
 - K. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems 2000 (Reaffirmed 2006).
 - L. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts 2023.
 - M. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility 2012 (Reaffirmed 2018).
 - N. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - O. UL 1598 - Luminaires Current Edition, Including All Revisions.
-

- P. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products Current Edition, Including All Revisions.

1.04 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 of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required 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, 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.
 - b. Include IES LM-79 test report upon request.
 2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IES LM-63 standard format upon request.
 3. Poles: Include information on maximum supported effective projected area (EPA) and weight for the design wind speed.
- D. 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.
- 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. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 60 00 - Product Requirements, for additional provisions.
- H. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

1.06 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. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 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.

1.08 WARRANTY

- A. See Section 01 77 00 - Closeout Submittals for City of Madison additional warranty requirements.
- B. Provide three year manufacturer warranty for all LED luminaires, including drivers.

PART 2 PRODUCTS**2.01 LUMINAIRE TYPES**

- A. Furnish products as indicated in luminaire schedule included on the drawings.
- B. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 LUMINAIRES

- A. Manufacturers:
 - 1. Acuity Brands, Inc: www.acuitybrands.com/#sle.
 - 2. Alloy LED; www.alloyled.com/#sle.
 - 3. Cooper Lighting, a division of Cooper Industries: www.cooperindustries.com/#sle.
 - 4. Electro-Matic Visual, Inc; www.empvisual.com/#sle.
 - 5. Hubbell Lighting, Inc: www.hubbelllighting.com/#sle.
 - 6. Philips Lighting North America Corporation; www.lightingproducts.philips.com/#sle.
 - 7. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Provide products that comply with requirements of NFPA 70.
- C. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- D. Provide products listed, classified, and labeled as suitable for the purpose intended.
- E. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, drivers, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- F. 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.
- G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- H. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.
- I. 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.
- J. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.
- K. 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.

- L. LED Tape Lighting Systems: Provide all power supplies, drivers, cables, connectors, channels, covers, mounting accessories, and interfaces as necessary to complete installation.
 - 1. LED Tape - General Requirements:
 - a. Listed.
 - b. Designed for field cutting in accordance with listing.
 - c. Wet Location Applications: IEC 60529, IP 68 (waterproof) rated.
 - 2. White LED Tape:
 - a. Correlated Color Temperature (CCT): _____ K unless otherwise indicated.
 - b. Color Rendering Index (CRI): Not less than 90.
- M. Exposed Hardware: Stainless steel.

2.03 DRIVERS

- A. Manufacturers:
 - 1. General Electric Company/GE Lighting: www.gelighting.com/#sle.
 - 2. OSRAM Sylvania, Inc: www.osram.us/ds/#sle.
 - 3. Philips Lighting North America Corporation; www.usa.lighting.philips.com/#sle.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
 - 5. Manufacturer Limitations: Where possible, for each type of luminaire provide drivers produced by a single manufacturer.
- B. Dimmable LED Drivers:
 - 1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
 - 2. Control Compatibility: Fully compatible with the dimming controls to be installed.

2.04 POLES

- A. Manufacturers:
 - 1. Acuity Brands, Inc: www.acuitybrands.com/#sle.
 - 2. Cooper Lighting, a division of Cooper Industries: www.cooperindustries.com/#sle.
 - 3. Hubbell Lighting, Inc: www.hubbellighting.com/#sle.
 - 4. Philips Lighting North America Corporation; www.lightingproducts.philips.com/#sle.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. All Poles:
 - 1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.
 - 2. Structural Design Criteria:
 - a. Comply with AASHTO LTS.
 - b. Wind Load: Include effective projected area (EPA) of luminaire(s) and associated supports and accessories to be installed.
 - 3. Mounting: Install on concrete foundation, height as indicated on the drawings, unless otherwise indicated.
 - 4. Unless otherwise indicated, provide with the following features/accessories:
 - a. Top cap.
 - b. Handhole.
 - c. Anchor bolts with leveling nuts or leveling shims.
 - d. Anchor base cover.
 - e. Provision for pole-mounted weatherproof GFI receptacle where indicated.
- C. Metal Poles: Provide ground lug, accessible from handhole or transformer base.

2.05 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.
- C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

PART 3 EXECUTION

3.01 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.

3.02 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.

3.03 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 05 33.16 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. Provide required support and attachment in accordance with Section 26 05 29.
- F. Provide required seismic controls in accordance with Section 26 05 48.
- G. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- H. Recessed Luminaires:
 - 1. Install trims tight to mounting surface with no visible light leakage.
 - 2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
 - 3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.
- I. Suspended Luminaires:
 - 1. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
- J. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- K. Pole-Mounted Luminaires:
 - 1. Maintain the following minimum clearances:
 - a. Comply with IEEE C2.
 - b. Comply with utility company requirements.
 - 2. Foundation-Mounted Poles:
 - a. Provide cast-in-place concrete foundations for poles as indicated, in accordance with Section 03 30 00.
 - 1) Install anchor bolts plumb per template furnished by pole manufacturer.
 - 2) Position conduits to enter pole shaft.

- b. Install foundations plumb.
- c. Install poles plumb, using leveling nuts or shims as required to adjust to plumb.
- d. Tighten anchor bolt nuts to manufacturer's recommended torque.
- e. Install non-shrink grout between pole anchor base and concrete foundation, leaving small channel for condensation drainage.
- f. Install anchor base covers or anchor bolt covers as indicated.
- 3. Embedded Poles: Install poles plumb as indicated.
- 4. Grounding:
 - a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.
 - b. Provide supplementary ground rod electrode as specified in Section 26 05 26 at each pole bonded to grounding system as indicated.
- 5. Install separate service conductors, 12 AWG copper, from each luminaire down to handhole for connection to branch circuit conductors.
- L. Install accessories furnished with each luminaire.
- M. Bond products and metal accessories to branch circuit equipment grounding conductor.
- N. Install lamps in each luminaire.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 45 16 - Field Quality Control Procedures for City of Madison 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 drivers as determined by Architect.

3.05 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. 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.

3.06 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.

3.07 CLOSEOUT ACTIVITIES

- A. See Section 01 77 00 - Closeout Submittals for City of Madison closeout submittals.
- B. See Section 01 79 00 - Demonstration and Training for City of Madison additional requirements.
- C. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.
- D. Just prior to Substantial Completion, replace all lamps that have failed.

3.08 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

SECTION 27 00 05 COMMUNICATIONS CABLING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This section specifies the City of Madison requirements for product design, performance, quality assurance, and contractor responsibilities for the execution of work to install a complete Category 6 (CAT6) structured cabling system.
- B. Execution of work includes but is not limited to the delivery and storage of materials, preparation, installation, field testing, and project completion tasks.
- C. System certification and warranty requirements for completed work and future moves, adds, and changes (MACs) are also specified in the section.

1.02 RELATED SPECIFICATIONS

- A. Section 01 33 23 - Submittals
- B. Section 27 21 33 - Wireless Access Points (WAP)

1.03 CONTRACTOR QUALIFICATIONS

- A. The Contractor shall have experience in the installation and testing of similar systems as specified in the plans and specifications for this contract.
 - 1. The Contractor shall have completed at least 2 projects of similar size and scope within the last 24 months.
 - 2. The contractor shall provide references upon request. Information to provide shall include IMAGINATION CENTER AT REINDAHL PARK, address, date of installation, client name, title, telephone number, and project description.
- B. The Contractor shall be certified by the connectivity manufacturer to install, service and warranty the specified product from the time of bidding through the duration of the contract installation and warranty period.
- C. The Contractor must maintain a State Contractors License as required by the State of Wisconsin.
- D. All members of the Contractors installation team must be certified by the manufacturer as having completed the necessary training to complete their part of the installation. All personnel shall be adequately trained in the use of tools and equipment required for the complete installation.
- E. The Contractor shall own and maintain tools, installation equipment, and testing equipment necessary for the successful installation and testing of Optical and Category 6, and 6A premise distribution systems.
- F. The Owners reserves the right to require the Contractor to remove from the project any such employee the Owner deems to be incompetent, careless, or insubordinate.

1.04 DRAWINGS AND INSPECTION OF THE SITE

- A. The Communication (Technical) floor plan drawings are in PDF format, are not typically dimensioned, and should not be scaled. The contractor should refer to the Architectural sheets and construction details for dimensions.
- B. The Contractor shall review all site conditions prior to submitting a bid for this project. Any obvious discrepancies between site conditions and the bidding documents shall be brought to the attention of the Architect/Engineer immediately so clarification can be made to the bidding documents by addendum.
- C. Any existing wires, utilities, or equipment shown on the drawings as existing are for general information and to the best knowledge of the Architect/Engineer. The contractor shall field verify all existing conditions.

- D. The contractor shall field verify distances and equipment placements, and coordinate all installation locations with other trades, construction managers and the general contractor prior to installation.
- E. Change order requests for additional material or labor costs due to the contractor's lack of knowledge of existing field conditions will not be allowed.

1.05 SUBMITTALS

- A. The Contractor shall review Section 01 33 23 Submittals for additional information.
- B. The Contractor shall provide a complete submittal package prior to ordering equipment and materials. Partial submittals will not be considered. A complete submittal shall include but not be limited to the following:
 - 1. Manufacturers data (specifications, "Cut Sheets")
 - 2. Wiring diagrams for all installed cabling
 - 3. Equipment rack and cabinet layouts
 - 4. List of cabling distances (typical and maximum) for all structured cabling
- C. The Contractor shall provide all license and certification documents for the project manager and all project technicians as part of the product submittal. All documents shall be valid through the completion of the installation and warranty period. Documents shall include but not be limited to the following:
 - 1. State of Wisconsin Contractors license
 - 2. Structured cabling and termination equipment installation certifications for:
 - a. Copper
 - b. Optical Fiber Connectivity
 - c. Cabling
- D. Product submittals are required for sole source products.
- E. Product submittals are not required for Owner provided equipment and materials. However miscellaneous materials required for a complete installation of Owner provided equipment may be necessary.
- F. Work shall not proceed until all submittal items have been approved.

1.06 PRODUCT SUBSTITUTIONS

- A. The Contractor shall thoroughly review all specifications associated with the Division 27 installations for product specific information.
- B. Substitutions for sole sourced products will not be permitted.
- C. Substitutions for items to be considered as equals shall be submitted for review at the time of bidding in accordance with the bidding instructions. Approved substitutions will be identified by a written addendum to the bidding documents prior to the end of bidding. Only items in the approved addendum will be allowed as substitutions.

1.07 TESTING

- A. See Part 3.

PART 2 PRODUCTS

2.01 GENERAL

- A. This section indicates pre-approved product manufacturers, specific products, or minimum product performances. Substitutions/alternates to this information shall only be allowed as described in paragraph 1.07 above.
- B. The manufacturer of the connectivity products specified in this document as required for construction of the cabling infrastructure shall be:
 - 1. Hubbell Premise Wiring

- C. The manufacturer of the cabling products specified in this document as required for construction of the copper cable infrastructure shall be:
 - 1. Mohawk Cable
- D. The manufacturer of the fiber optic cabling products specified in this document as required for construction of the fiber optic cable shall be:
 - 1. Mohawk Cable
 - 2. Pre-approved equal

2.02 WORK AREA CONNECTORS

- A. Category 6 Jacks
 - 1. Jacks shall be standard 8-position, RJ-45 style, un-keyed, FCC compliant
 - 2. Jacks shall be designed for 4-pair, 100 Ohm balanced un-shielded twisted pair (UTP) cable.
 - 3. Jacks shall terminate 26-22 AWG solid or stranded conductors.
 - 4. Jacks shall include a dust cap for wire retention.
 - 5. Jacks shall accept FCC compliant 6-position plugs.
 - 6. Jacks shall have attached wiring instruction labels to permit either T568A or T568B wiring configurations.
 - 7. CAT6 jacks shall be backward compatible with existing category 3, 5, and 5E cabling systems for fit, form and function.
 - 8. Jacks shall be manufactured in the USA.
 - 9. CAT6 jacks shall meet or exceed CAT6 transmission requirements for connecting hardware as specified in ANSI/TIA/EIA-568-C-2 transmission performance specifications for 4-pair 100 ohm cable.
 - 10. Jacks shall be UL listed and CSA certified.
 - 11. Colors shall be specified by the Owner.
 - 12. CAT6 modular jacks shall be:
 - a. Hubbell
 - 1) HXJ6EI (Category 6 – Ivory)

2.03 FACE PLATES

- A. All faceplates shall meet the following specifications
 - 1. Faceplates shall UL listed, CSA certified, and shall be constructed of high impact UL94 V-0 rated thermoplastic.
 - 2. Faceplates shall be compatible with standard NEMA openings and boxes.
 - a. Faceplates for single gang boxes shall be 2.75" W x 4.5" H (69.8 mm x 114.3 mm).
 - b. Faceplates for double gang boxes shall be 4.5" W x 4.5" H (114.3 mm x 114.3 mm).
 - c. Mounting screws shall #6-32 pan head Phillips/slotted and color matched to the faceplate.
 - 3. Port size in each faceplate shall fit the CAT6 modular jack or snap-fit fiber optic, audio, and video modules for multi-media applications.
 - 4. Faceplates shall be rear loading with a designation window.
 - 5. Faceplates shall be provided with clear plastic and color matched label field covers, and shall provide ANSI/TIA/EIA-606-A compliant workstation outlet labeling.
 - 6. Work area faceplates shall be
 - a. Hubbell (IFP series)
 - 1) IFP14W (4-port White)

2.04 CABLE

- A. Category 6 UTP
 - 1. Ceilings in the project are non-plenum,
 - 2. Non-plenum cable construction shall be four twisted pairs of 23AWG insulated solid conductors with a ripcord surrounded by a tight outer jacket.
 - 3. No minimum compliant cable will be accepted, this facility requires additional band width.

4. The ripcord shall be directly underneath the outer jacket.
5. Cable shall be marked with the manufacturer and pertinent information. UL, ETL, or CSA agency certification or verification markings shall be on the cable jacket according to the certifying agency's requirements.
6. Color coding of pairs shall be as follows:
 - a. Pair 1: white/blue; blue
 - b. Pair 2: white/orange; orange
 - c. Pair 3: white/green; green
 - d. Pair 4: white/brown; brown
7. Cable shall be supplied in 1000 foot spools or 1000 foot Reelex boxes.
8. Cable shall exceed CAT6 transmission requirements specified in ANSI/TIA/EIA-568-C-2.
9. Cable shall be UL and C(UL) listed.
10. Cable shall exceed the requirements of TIA/TSB-155, 10 GB/S Ethernet operation over 37 meters channel length.
11. CAT6 UTP horizontal distribution cable as specified in the contract documents shall be
 - a. Mohawk Advancenet Cable
 - 1) Plenum M57193
 - 2) Riser M57202
 - 3) Non-plenum M57202

2.05 PATCH PANELS – CATEGORY 6

- A. CAT6 patch panels shall be standard 8-position, RJ-45 style, un-keyed, FCC-compliant receptacle in 24 and 48 port configurations.
- B. Panel frames shall be black powder coated 14 gauge steel with rolled edges on top and bottom for proper stiffness.
- C. Panels shall accommodate a minimum of 24 ports for each rack mount unit (1 RMU=1.75 inches). 48 ports are recommended.
- D. Panels shall be designed for 4-pair, 100 ohm balanced unshielded twisted pair (UTP) cable.
- E. Panels shall terminate 26-22 AWG solid connectors
- F. Panels shall have individual port identification numbers on the front and rear of the panel. Panels shall have the CAT6 designation visible from the front when installed.
- G. Printed circuit boards shall be fully enclosed front and rear for physical protection.
- H. Panel contacts shall accept a minimum of 2000 mating cycles without degradation of electrical or mechanical performance.
- I. Panel termination method shall follow the industry standard 110 IDC punch-down using a standard 110 impact termination tool.
- J. CAT6 panels shall be backward compatible with existing category 3, 5, and 5E cabling systems for fit, form, and function.
- K. CAT6 patch panels when installed shall exceed the link or channel performance requirements of ANSI/TIA/EIA-568-C.2.
- L. CAT6 patch panels shall be able to accommodate 10G in a 37 meter channel per TSB-155.
- M. CAT6 patch panels shall be:
 1. Hubbell (Nextspeed 6 series)
 - a. 24 port – P6E24U
 - b. 48 port – P6E48U

2.06 RACKS – FREE STANDING – 2 POST

- A. Rack material shall be structural aluminum with durable black polyurethane powder coat finish.
- B. Installed racks shall have a static load capacity of 500 lbs.

- C. Racks shall be available in either 19 inch or 23 inch standard rack configurations
- D. Tapped holes in the vertical rails for mounting of panels shall be #12-24 thread size. Coating shall not interfere with the thread fit.
- E. The standard rack height shall be 7 feet (84 inches) and have a capacity of 45RMU.
- F. Rack base angles shall be pre-drilled for floor mounting and for assembly to vertical rails.
- G. Racks shall accommodate expansion of cable capacity and added volume for CAT6 cabling.
- H. Free standing racks and accessories shall be:
 - 1. Hubbell (Nextframe series)
 - a. HPW84RR19
- I. NOTE: Each basic rack delivered shall consist of equipment rack, isolation pads, 18" wide black ladder rack and mounts to secure to the rack, a vertical electrical 20 amp outlet strip (minimum of 6 receptacles) with mounting brackets.

2.07 CABLE MANAGEMENT – VERTICAL

- A. See plans for locations.

2.08 CABLE MANAGEMENT - HORIZONTAL

- A. See plans for locations.

PART 3 EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING

- A. Materials delivered to the site shall be stored in a clean, dry, and secured area, preferably indoors and shall not interfere with other construction activity.
- B. Storage temperature shall adhere to the manufacturer's recommendations.
- C. Handling of any materials packaged or un-packaged shall be in such a manner as to avoid damage to the item.
- D. Installation of CAT6 cable shall be within the recommended temperature range specified by the manufacturer. Cable installation temperature shall above 50 f is recommended.

3.02 PREPARATION

- A. Cable Pathways and Firestops
 - 1. Cable pathways including but not limited to conduit, cable trays, ladder racks, raceway, slots, sleeves, etc. shall be located and mounted according to the contract drawings and manufacturers installation instructions. Pathways shall not be installed in wet areas.
 - 2. Cable pathway fill ration, bend radius , run length, number of bends, and proximity to EMI sources shall be in accordance with ANSI/TIA/EIA-569-B. Maximum cable count of the initial installation shall not exceed 40% fill ration in any one pathway.
 - 3. In accordance with NEC power wiring and communications cabling shall not share the same pathway or outlet unless separated by a physical barrier.
 - 4. Cable pathways shall be secured to a structural member of the building or permanent wall studs. Wall surfaces for raceway mounting should be finished complete.
 - 5. Metallic pathways shall be electrically continuous, free of sharp edges, and properly bonded to an approved ground. EMI sources such as ballasts, motors, and bus conductors shall be avoided by using proper separation distances.
 - 6. Pathways that penetrate fire-rated barriers shall be fire stopped according to local codes and recognized practices. Fire stop materials or devices shall be qualified to UL-1479 in accordance with ASTM E814. Fire stop method shall have the Architect/PE approval.
 - 7. core drilling of holes for fire-rated poke through outlet devices shall have approval of the structural engineer or PE on the contract drawings prior to starting the work.

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8. Pathways for vertical cable runs such as slots and sleeves shall be installed in the proper location in accordance to applicable codes and standards.
- B. Telecommunication Rooms and Equipment Rooms
1. Telecommunication Room (TR) layout and location shall be in accordance with the guidelines of ANSI/TIA/EIA-569-B. TR's shall not be installed in wet areas, near EMI sources, or caustic chemicals.
 2. Layouts of rack, cabinet, or enclosure locations shall be according to the approved submittal drawings.
 3. Racks and cabinets shall be secured to the floor using proper anchors and fasteners.
 4. Mount and assemble racks, cabinets, brackets, and enclosures per the manufacturer's installation instructions. Mount patch panels and cable management accessories in the specified sections.
 5. Adjoining pathways (ladder rack, cable tray, etc.) shall be properly secured and positioned to allow adequate bend radius of cables entering the rack or cabinet.
- C. Wall outlets and recessed wall boxes
1. Wall outlet and cable drop pathway location shall be according to contract drawings. Guidelines from ANSI/TIA/EIA -569-B should be followed for location with electrical outlets, and outlet height above finished floor.
 2. Outlet boxes shall be fastened securely to a wall stud or structural element in a manner that permits flush mounting of the faceplate with the finished wall.
 3. Multi-connect boxes shall be installed in a manner to comply with separation rules for power and communications wiring in close proximity.
 4. Refer to specific manufacturer's recommendations for wall outlet selection, cable deployment, and termination of jacks into faceplates.
- D. Surface housings and MUTOA outlets
1. Raceway or conduit should be deployed to the surface housing location for through wall cable entry. Cut the wall opening to match the location in the housing base.
 2. Layout mounting holes onto the desired wall location. For wallboard, concrete, or cinder block walls drill to the proper depth and install anchors.
 3. Always use the appropriate wall anchors for the wall material being anchored to. Installing mounting screws without using anchors will not be permitted. Mounting to studs is preferred.
 4. Mount base plate or surface box or MUTOA to outlet location using the proper fasteners. Note: furniture and wall outlet applications require mounting of the base plate prior to cable pulling and connector termination.
 5. Install cover and base plates.
 6. Refer to detailed manufacturer's guidelines for cable deployment and termination of jacks into surface housings. Due to the larger size of CAT6 cables proper cable bend radius must be maintained. Certain restrictions may apply when dressing CAT6 cabling in to surface housings.

3.03 INSTALLATION

- A. Cable Support
1. The contractor shall install all supports for cables specified in this section. Traditional ladder rack shall be used in each Telecommunication Room. Basket and J-hooks shall be used for horizontal cable support.
 2. Cable supports shall be spaced randomly but no further than 5'-0" apart.
 3. The Contractor shall provide all incidental cable management products required for a complete and neat cabling installation. Incidental products include but are not limited to sleeves or conduit raceways required to protect exposed cabling.
 4. A horizontal conduit system consists of conduits radiating from the telecommunications Room to the workstation outlets in the floor, walls, ceilings, and columns of the building. When using a conduit distribution system utilize the most direct route following the building lines.

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5. Provide a minimum of 1-inch conduit to each workstation location from the cable tray for voice and data cables.
 6. Conduit fill ratios shall not exceed 40%. Contact the cable manufacturer to get recommendations on fill rates.
 7. No conduit run should be designed with more than two (2)-90 degree bends between pull points or pull boxes. If a run requires more than two (2)-90 degree bends install a pull box.
 - a. Exceptions to this shall be as follows:
 - 1) The total run is not longer than 33 feet.
 - 2) The conduit size is increased to the next trade size larger.
 - 3) One of the bends is located within 12 inches of the cable feed end (this exception only applies to placing operations where cable is pushed around the first bend).
 8. All conduits shall be equipped with a contiguous length of plastic or nylon pull string with a minimum rating of 200 lbs (90 Kg).
 9. A conduit run shall not be designed with continuous closed sections longer than 100 feet without pull points or pull boxes installed.
 10. All conduits should terminate above on the installed ladder racks or cable tray and allow for proper cable racking. Cable materials should be considered in areas that have excessive distance between the conduit and ladder rack.
 11. Trays and conduits located within the ceiling shall protrude into the room a distance of 1 to 2 inches without a bend and at least 8 feet above finished floor. Clear unobstructed access to the ladder rack and conduits shall be provided within Telecommunications Rooms.
 12. Conduits entering through the floor shall terminate at least two (2) inches above the finished floor.
 13. Locate slot/sleeve systems in places where pulling and termination will provide the easiest access.
 14. If possible locate sleeves, slots, and/or conduits on the left side of the room. This placement enhances the use of wall space from left to right.
 15. When possible entrance conduit and distribution conduit/cable tray should enter/exit on the same wall. If this is not possible provide and install ladder rack inside the room for distribution from wall to wall.
 16. All floor penetrations shall be core drilled with a maximum of 1/4 inch size greater than the exterior diameter of the riser conduit.
 17. Conduits entering through a wall shall be reamed, bushed, and terminated as close as practicable to the terminating rack or wall.
 18. Terminations above the suspended ceiling shall terminate no less than 3 inches above the finished ceiling and shall be finished with a bush opening.
 19. All conduit shall be labeled for easy identification. Label once in each room.
 20. All floor penetrations shall be at columns, exterior walls, or in equipment rooms.
 21. Cables shall be supported at the height of the bottom flange of structural beams using a rigid support method (I.E. threaded rod, beam clamps, etc.)
 22. Do not support cables from duct work, sprinkler piping, water piping, waste/vent piping, conduit, ceiling wire, or other support systems.
 23. The conduits or sleeve will be installed per TIA/EIA-569-B and shall have all penetrations sealed with an approved fire stop product.
 24. Provide independent support systems for each low voltage cabling system.
- B. Cable
1. CAT6 cable will be run for data. Certain environments may require the use of different cables and/or cable jackets.
 2. All terminations shall utilize T568B wiring. The Contractor shall be responsible for removing/replacing any wiring that is not in compliance with this requirement at no additional cost to the owner.
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3. Maximum cable lengths to be 295 feet (90 m) including the service loop. Provide all necessary installation materials, tools, and equipment to perform insulation displacement type terminations at all communications outlets and patch panels.
4. All communication cabling that has become abandoned as part of new renovation, previous renovation, or used as temporary communication cables during the construction process shall be completely removed.
5. Refer to detailed manufacturers guidelines for deployment of CAT6 cable. Certain restrictions apply and specific techniques are recommended.
6. All cabling shall be installed in accordance with the manufacturers written bend radius and pulling tensions. General industry guidelines recommend the following:
 - a. Tensile loading of a single 4-pair copper UTP cable shall not exceed 25 LBF
 - b. Bend radius of a single 4-pair copper UTP cable shall be a minimum of 4 times the diameter of the cable.
7. All conduits and conduit sleeve shall have bushings or grommets installed prior to the installation of communications cables to avoid damage and abrasions to the cable sheathing and insulation. If bushings are not installed by the electrical contractor the communications cabling contractor shall furnish and install bushings prior to pulling communications cabling.
8. Horizontal cable length for 4-pair copper UTP cables shall not exceed 295 feet. The contractor is responsible for reviewing the plans and specifications prior to bidding and installation and shall notify the Communications Design Engineer of cable runs that may exceed 295 feet.
9. Splices shall not be permitted in any voice or data cable unless otherwise specified or shown on the drawings.
10. Copper cables shall not be placed near sources of extreme heat (I.E. boilers, radiators, heat coils, etc.).
11. Maintain cable twists for all UTP cables. For terminations, cable sheathing shall be stripped back no more than 1/2 inch from the termination point for all CAT6 cables.
12. All cables shall be supported by cable tray, cable runway, or J-hooks. When large quantities of cables leave trays or runways, cables shall be supported by drop-outs or cable support hardware manufactured specifically for the purpose of supporting cables. J-hooks shall be installed a minimum of every 5 feet and cabling shall maintain minimal deflection and strain (less than 12" deflection). Cables shall not be supported from ceiling grid wires. Cables shall not run above steel joists.
13. All cables shall be separated and bundled into like groups.
14. Service loops shall be provided at both ends of installed horizontal and backbone cabling. A 12" service loop shall be installed in the ceiling space near workstation outlets (excessive cable shall not be coiled in outlet boxes). A 10 foot service loop shall be provided in Telecommunication rooms and shall be installed to allow for future equipment rack/cabinet relocations without the need to re-terminate patch panels. The 10 foot service loop shall be neatly bundled and secured in the ceiling space with large D-rings or placed in cable trays. Cable slack and service coils shall be stored properly above the ceiling or under the access floor. A "figure-eight" service loop is recommended for CAT6 cabling to reduce EMI coupling. Loose random bundling is recommended.
15. Any cabling installed in equipment rooms shall be neatly placed in cabling trays, cabling runways, or horizontal and vertical rack/cabinet cable management devices.
16. Only Velcro straps shall be utilized for cable bundling. Tie wraps, zip ties, and other such rigid devices will not be permitted when bundling cables.
17. Maintain the following separation distances between cables, other system cables, and other building systems:
 - a. One (1) foot from fluorescent lights
 - b. One (1) foot from power cables in parallel
 - c. One (1) foot from electrical conduits or other system cables and electrical equipment
 - d. Four (4) feet from motors and transformers
 - e. Three (3) feet from hot water piping and other mechanical equipment

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- f. Ten (10) feet from bus conductors or high current branch circuits
 - g. All low voltage cables shall be run parallel or at right angles to building structural framework. Do not run cables diagonally across ceiling space without written authorizations by the Communications design Engineer or the Owners Representative.
 - h. Communications cabling that must cross power cables or conduit shall cross at a 90 degree angle and shall not make physical contact.
- 18. Fire seal around all cables running through rated floors and walls. Firestop all cables and pathways that penetrate fire-rated barriers using approved methods, materials and in accordance with all local codes.
 - 19. Contractor shall install a spare pull string with every outlet installed.
 - 20. Do not install cable in wet areas, or in proximity to hot water pipes and boilers.
 - 21. Termination ends of cables shall be clean and free from crush marks, cuts, or kinks left from pulling operations. Installed cable jackets shall have no abrasions with exposed conductor insulation or bare copper "shiners". The contractor shall be responsible for replacing any damaged cables.
 - 22. Backbone cables shall be installed and bundled separately from horizontal distribution cables. Backbone and horizontal cable bundles shall be loose and random.
 - 23. Back bone cables spanning more than three floors shall be supported at the top of the cable run with wire mesh grip and on alternating floors unless otherwise specified by local codes or manufacturers guidelines.
 - 24. Vertical runs of backbone cables entering each Telecommunications Room shall be securely fastened along a properly prepared wall in the room on each floor. Provide cable ladders.
- C. Communications Infrastructure
- 1. Maximum cable lengths shall be 295 feet (90 m) including the service loop. Provide all necessary installation materials, tools and equipment.
 - 2. Support and secure cables at patch panel using rear cable management bracket, spools or management devise.
 - 3. Cross-connects shall be completed as per the construction schedule.
- D. Racks and Enclosures
- 1. Freestanding equipment racks and enclosures shall be protected of all dust, debris, and other environmental elements during construction until the punch list walk through.
 - 2. Each rack or enclosure shall have a dedicated #6 AWG ground wire to a grounding busbar or building ground as defined by the NEC.
 - 3. Secure racks and enclosures to the floor using the manufacturers rack installation kit.
- E. Category 6 Jacks
- 1. Refer to specific manufacturer's guidelines for termination of jacks and dressing CAT6 cables inside wall outlets and surface housings. Due to the larger size of CAT6 cable service coils in outlet boxes and surface housings are not recommended.
 - 2. Terminate all jacks according to manufacturer's instructions.
 - 3. All jacks shall be wired using T568B.
 - 4. The contractor shall maintain wiring pair twists as close as possible to the point of termination to assure 10G Base-T performance. Minimize the length of exposed pairs from the jacket to the IDC termination point during installation.
 - 5. The length of wiring pair un-twist in each termination shall be less than 0.5 inches (13mm).
 - 6. Jacks shall be properly mounted in plates, frames, or housings with dust caps fully installed over IDC contacts.
 - 7. Horizontal cables extending from mounted jacks shall maintain a minimum bend radius of at least 4 times the cable diameter unless space is restricted. Note: refer to specific manufacturers recommendations for restricted cable bend radius.
 - 8. Cable terminations shall minimize tensile or bending strain on the IDC contacts after assembly of the faceplate or housing to the wall outlet.
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F. Category 6 Patch Panels

1. Properly mount patch panels into the designated rack, cabinet, or bracket locations with the #12-24 screws provided
2. Terminate cables behind the patch panel according to the manufacturer's installation instructions.
3. To insure proper performance the contractor shall maintain wiring pair twists as close as possible to the point of termination and minimize the length of exposed pairs from the jacket to the IDC termination point during installation.
4. The length of wiring pair un-twist in each termination shall be less than 0.5 inches (13 mm) and shall be kept to a minimum.
5. Each terminated and dressed cable shall be maintained perpendicular to the rear cover using the recommended cable management hardware.
6. Horizontal or backbone cables extending from the rear panel terminations shall maintain a minimum bend radius of at least 4 times the cable diameter.
7. Cable terminations shall have a minimal tensile or bending strain on panel IDC contacts in each installed location.
8. Panels shall be properly labeled on the front and back with the cable number and port connections for each port.

G. Harsh Environment Housing and Connectivity

1. Mount connector housing from the front of the device. Install gasket or optional protective cap before mounting connector housing into device.
2. Secure connector housing to device using supplied plastic nut. Tighten nut with 6-7 inch/pounds of torque.
3. Ensure that mounting surface is clean and free of debris.
4. Installing the jack into the mounted connector housing.
5. Install the terminated jack into the mounted connector housing by tilting the jack and securing the fixed latch in the connector opening. Rotate the jack securing the spring latch.
6. Clean and remove any obstructions from the surface that the wall plate assembly will be installed against.
7. Place washers provided with hi-impact series plates onto screws. Align rubber gasket on the back side of plate prior to installing to the box/wall by placing screws through plate and rubber gasket.
8. Secure the wall plate assembly to box/wall by tightening screws with 5 inch/pounds of torque.
9. Attach patch cords and field terminate plug assemblies (sold separately) to the mounted connector.

H. Grounding and bonding systems, basic guidelines

1. Telecommunications grounding and bonding system shall be installed in accordance with NEC requirements and per the guidelines of ANSI J-STD-607-A.
2. The telecommunications main grounding busbar (TMGB) shall be bonded to the building main electrical service ground (grounding electrode conductor or GEC) using approved lugs or exothermic weld methods. Bonding to the GEC or TMGB with sheet metal screws is prohibited.
3. the telecommunications bonding backbone shall be a minimum of #6 AWG copper wire conductor. A telecommunications grounding busbar (TGB) shall be installed in the Telecommunications Room on each floor, and call be bonded to the TBB. All metal racks, cabinets, pathways, and enclosures shall be bonded to the TGB.
4. Telecommunications equipment shall be grounded according to manufacturer's instructions and in accordance with all applicable codes.
5. All metallic pathways including conduit, raceway ladder, or cable trays shall be electrically continuous and shall be bonded to ground on each end.
6. OSP cable entering the building or backbone cables having metal sheaths shall have isolation protections. Isolation protectors shall be bonded to the TMGB.

3.04 LABELING

A. General

1. All labels shall be permanent and machine generated by a labeling machine as follows:
 - a. Labels shall be on a permanent polyester material, clear in color.
 - b. Lettering shall be black in color.
 - c. Hand written labels will not be permitted.
2. The Contractor shall coordinate the labeling scheme with the Owner prior to producing and installing any labels. The Contractor shall provide samples of finished installations at a pre-installation meeting with the Owner prior to completing the installation. In general, the labeling scheme shall be: IDF Room # - Room # - Jack #.
3. Surfaces shall be cleaned before attaching labels. All labels shall be attached firmly and vertically plumb on equipment, faceplates, patch panels, termination blocks, etc.
4. All labeling of cables, equipment, and components shall be included in as-built documentation, floor plan drawings, schematic designs, and test reports.

B. Cabling

1. All structured cables (horizontal and backbone) shall be labeled at both ends within 6" of cable termination point. Where voice backbone cables extend behind termination blocks cable labels shall be placed at a location on the cable where the labels are visible from the front of the termination block.
2. Labels shall have an adhesive backing and shall wrap completely around the circumference of the cable jacket. Label and lettering shall be of an appropriate size with regards to the cable diameter.

C. Equipment Racks, Termination Hardware, and Faceplates

1. The Contractor shall coordinate the labeling scheme with the Owner prior to producing and installing any labels. The Contractor shall provide samples of finished installations at a pre-installation meeting with the Owner prior to completing the installation.

3.05 TESTING

A. Category 6 Cable Testing

1. Permanent link testing shall be completed on all horizontal (station) cables. The Contractor shall be responsible for supplying a channel warranty but the Owner requires that the contractor supplies all the manufacturer's patch cords per the contract.
2. CAT6 cabling systems shall be tested as an installed horizontal permanent link configuration. Jacks and faceplates shall be assembled, complete and properly mounted into outlet boxes. Panels shall be terminated complete and fully dressed with proper cable management.
3. All CAT6 cables shall be properly labeled prior to testing. Test results shall be in numerical order by Cable ID.
4. All wiring shall be certified to meet or exceed the specifications as set forth in TIA-568C for CAT6 requirements for permanent link. All tests shall be performed to 250 Mhz.
5. Test results shall include the following information for each pair of each cable installed:
 - a. Name of the person performing the test.
 - b. Test equipment manufacturer and model number.
 - c. Cable ID.
 - d. Date of Test
 - e. Wire map (pin to pin connectivity and polarity check)
 - f. Length (in feet)
 - g. Insertion loss
 - h. Near end cross talk (Next)
 - i. Power sum near end crosstalk (PSNEXT)
 - j. Equal level far end crosstalk (ELFEXT)
 - k. Power sum equal level far end crosstalk (PSELFEXT)

- l. Return loss
 - m. Delay skew
 - n. Attenuation to crosstalk ratio (ACR)
- 6. A "PASS" indication shall be obtained for each link using (at minimum) a level III tester that complies with TIA/EIA-568-B.2 field test requirements.
- 7. Correct all malfunctions and "FAIL" when detected and re-test to demonstrate compliance.
- 8. Record test results for each cable and provide to the General Contractor for the Owners review. All cables shall "PASS" as a condition of installation acceptance.

3.06 CONTRACT CLOSEOUT REQUIREMENTS

- A. Closeout Documentation. The Contractor shall assemble all closeout documentation required below and provide it digitally in a PDF, searchable (when applicable), format on a compact disc, thumb drive or other compatible digital device unless otherwise specified below. This documentation shall be kept separate from other similarly required documents and provided to the City of Madison Information Technology representative for review and approval. The documentation shall be provided and indexed as follows:
 - 1. Index of contents
 - 2. Pre-installation test results, one complete set in approved format indicating all pre-installation tests met or exceeded the specification
 - 3. Post-installation test results, one complete set in approved format showing all post installation terminations met or exceeded the specification
 - 4. As-Builts
 - a. The Contractor shall maintain through the construction process a paper set of as-built documentation. Upon completion of the installation and verification by the Owner and Design Engineer that all documentation is complete the contractor shall provide the Design Engineer with the paper plans for inclusion into a digital as-built design set.
 - b. Complete floor plan as-builts shall indicate all of the following information:
 - 1) Include detailed information of cable and pathway layouts, locations of pull points/boxes, and other such products and equipment installed.
 - 2) Locate all work station outlets, camera, locations and other such data drops; provide the correct alpha numeric cable assigned to each location.
 - 3) Where product/equipment locations are dimensionally located provide the installed dimensions by either circling the design dimension if correct or providing the field correct dimension. Provide all dimensions for installations not originally dimensioned in the design.
 - 4) Any deviation in location of an installation shall be noted on the drawings regardless of the reason for change. Items grossly not installed in their intended location shall be "X" out and drawn in the installed location
 - 5) Indicate all items added or deleted to the contract through change order or other such means. Provide the document number that caused the change.
 - c. Provide complete details of final installation of all racks and equipment. Provide the alpha-numeric numbers (range low to high) assigned to each patch panel on a rack.
 - 5. Operation and Maintenance information, all of the following items shall be grouped by like item for a specific product or piece of equipment.
 - a. A complete set of all submittals
 - b. A complete set of all installation instructions for products and equipment installed. Only one (1) copy of each product or piece of equipment needs to be supplied.
 - c. A complete set of all operation instructions for products and equipment installed
 - d. A complete set of all maintenance/care instructions for products and equipment installed
 - 6. Warranty/guarantee Information
 - a. Provide signed contractors warranty letter for installation and service for the period of one (1) year.

- b. Provide manufacturer's warranty/guarantee information for all products and equipment installed. Verify with all plans and specifications the required terms of warranties/guarantees. If none are specified provide the default manufacturer's warranty/guarantee.
- B. Owner Training. The Contractor shall provide Owner Training as needed on all Division 27 installations. The contractor shall verify with the City of Madison Information Technology representative as to what items will be trained, how much training will be necessary and coordinate training dates and times.

END OF SECTION

**SECTION 27 21 33
WIRELESS ACCESS POINTS (WAP)**

PART 1 GENERAL

1.01 SCOPE

- A. The work under this section is for the installation of OWNER PROVIDED, CONTRACTOR INSTALLED Wireless Access Points (WAP).
- B. The WAPs shall be installed by the contractor providing and installing the Communications Cable and Equipment. All contractor qualifications and certifications for that section shall apply to this section.

1.02 RELATED SPECIFICATIONS

- A. The Contractor shall be responsible for reviewing all other specifications for requirements associated with the complete installation of WAP's. This includes but is not limited to the following:
 - 1. 01 31 23 Project Management Web Site
 - 2. 01 33 23 Submittals
 - 3. 27 00 05 Communications Cabling

1.03 SUBMITTALS

- A. Contractor licenses and qualifications are required as part of the complete Division 27 submittal package as indicated under Specification 27 00 05.
- B. No submittals are required for the owner provided WAP.
- C. Submittals are required for installation/hanger equipment, connectors, and any other required equipment/material required for a complete WAP installation.

PART 2 PRODUCTS

2.01 WIRELESS ACCESS POINT (WAP) DEVICES

- A. The City of Madison Information Technology Department (CoM-IT) will be providing the WAP devices for this project.
- B. The WAP device being used will be as manufactured by the Cisco, Model 9130X and shall be used for all types of ceiling mounted installations (suspended, gyp board, open truss, etc).

PART 3 EXECUTION

3.01 OWNER RESPONSIBILITIES

- A. The CoM-IT shall be responsible for ordering, making payment (including shipping fees), and configuring all WAP devices in a timely manner to comply with the Contractors schedule.
- B. The CoM-IT shall configure and test each WAP to CoM-IT specifications prior to providing them to the contractor for installation.
- C. The CoM-IT shall number each WAP and provide the contractor with a location map indicating where each WAP will be installed.
- D. The CoM-IT shall test all WAP's after installation to verify configuration and signaling is correct prior to accepting the final installation of the WAP system.

3.02 CONTRACTORS RESPONSIBILITIES

- A. The Contractor shall be solely responsible for coordinating with CoM-IT the scheduling and receipt of all WAP devices with his/her installation schedule.
- B. The Contractor shall inspect all WAP devices upon receipt for damage. CoM-IT shall be notified immediately of any damage.
- C. The Contractor shall provide all mounting hardware, blocking, and other items required for a complete installation to the manufacturers installation requirements.
- D. The Contractor shall install all WAP devices per plans and specifications including cable connections.

- E. The Contractor shall be responsible to pick up WAP devices from City IT and delivery to the jobsite.

3.03 FINAL TESTING

- A. Contractor shall provide final testing of all WAP devices after installation is complete.
- B. In the event any WAP device is not operating properly the contractor shall trouble shoot the installation and work with the CoM-IT to determine if re-configuration of the device will be required.
- C. The CoM-IT shall be responsible for reconfiguring WAP's as needed after installation is complete. The contractor shall be responsible for verifying connections, cabling and connectivity of the installation is correct.

3.04 WARRANTY

- A. The CoM-IT will be responsible for registering any warranty information associated with the purchase and ownership of all WAP devices.
- B. The Contractor shall warrant the installation of the WAP device for one (1) year per the terms of this contract.

END OF SECTION

SECTION 27 41 00
PROFESSIONAL AUDIO/VIDEO SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

- A. This specification provides requirements applicable to all project audiovisual work including systems in the Community Room, Classroom, Pavilions, and the digital signage. See the plans and Sections listed under Related Work.

1.02 SECTION INCLUDES

- A. System Components.
- B. Audio Connectors.
- C. Audio Cabling.
- D. Video Connectors.
- E. Digital Video Cabling.
- F. Transmission Connectors.
- G. Transmission Cabling.
- H. Control Cabling.
- I. Horizontal Copper and Fiber Cabling and Connectors.

1.03 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.
- C. UL 1480 - Standard for Speakers for Fire Alarm and Signaling Systems, Including Accessories; Current Edition, Including All Revisions.

1.04 RELATED WORK

- A. Section 27 05 00 - Basic Communications Requirements.
- B. Section 27 41 16 - Parks Pavilion Audiovisual System.
- C. Section 27 51 16 - Library Audiovisual Systems.
- D. Section 27 51 23 - Flat Screens.

1.05 QUALITY ASSURANCE

- A. Manufacturer: The manufacturer of equipment shall have a complete service organization for all products in the manufacturer's line.
- B. Integrator/Dealer: The Contractor shall be a factory-authorized and certified integrator/dealer specializing in each elected manufacturer's products, with demonstrated prior experience with the selected manufacturer's system installation and programming.
- C. The following qualifications have been endorsed by the AudioVisual and Integrated Experience Association (AVIXA), which is formerly known as InfoComm International.
 - 1. The Contractor shall have the services of a Certified Technology Specialist on staff and supervising the project. This service shall not be subcontracted. In addition to supervising the project, the CTS-I shall perform the following tasks on the project:
 - a. Review submittals and provide a letter stating the submittals are in compliance with the contract documents.
 - b. Provide written and dated confirmation of an observation of the contractor's installation activities no less than every two (2) weeks per month during the construction period.
 - c. Provide a final written and dated confirmation of a final construction review prior to testing.

- d. Review final testing and calibration of the systems and provide a letter with the documented results or transmittal of the results stating the test results and calibration compliance with the contract documents.
- D. A certification of CCENT or CCNA from CISCO. CCNP certification satisfies either of these requirements.
- E. Control System Dealer: The media control system shall be provided, terminated, installed, and programmed by a factory-authorized and certified dealer and integrator in good standing with the manufacturer. The dealer shall have direct purchasing and support authority. These services shall be subcontracted.
- F. Control System Programmer: The media control system shall be programmed by a factory-trained and certified programmer.
 - 1. The Contractor shall have all certifications required by the manufacturer(s) for the installed system components on staff for the appropriate duties and responsibilities required by the manufacturer.
 - a. The control system programmer shall have all refresher courses completed for the latest features of the control platform prior to bidding the project to ensure that the Contractor is up to date with the latest software features.
 - b. The control system programmer shall have achieved the highest programmer level obtainable by the installed control manufacturer (e.g., master programmer).
 - 2. The Contractor shall be fluent in the control systems preferred language (e.g., Python, C#, Java, JavaScript, SQL, PHP, etc.) required to complete the programming requirement of the AV system.
- G. Audio System Programmer: All digital sound processing equipment (DSP) used on the project shall be setup, programmed and calibrated by a factory-trained and certified technician. All audio signals shall be delivered via Dante. Programmer shall provide the Owner with an auto-mixed program output as well as pre-fade signals from each source/input.
 - 1. The audio system programmer shall have the following complementary certifications:
 - a. Associated manufacturer certifications.
 - b. Dante Level III.
- H. Video System Programmer: All video distribution and processing used on the project shall be setup, programmed, and calibrated by a factory-trained and certified technician.
- I. The Contractor shall have acquired and maintained all certifications for a minimum of one (1) month prior to the posted bid date of this project.
- J. Servicing Contractor: The installer must be factory certified to provide service on the installed manufacturer's equipment and must have local service representatives within a 100-mile radius of the project site.

1.06 REFERENCES

- A. ADA – Americans with Disabilities Act.
- B. ADAAG – Americans with Disability Accessibility Guidelines.
- C. ANSI – American National Standards Institute.
- D. AVIXA – Audiovisual and Integrated Experience Association (Formerly InfoComm).
- E. ANSI/InfoComm A102.01:2017 – Audio Coverage Uniformity.
- F. ANSI/InfoComm 2M-2010 – Standard Guide for Audiovisual Systems Design and Coordination Processes.
- G. ANSI/InfoComm F501.01:2015 – Cable Labeling for Audiovisual Systems.
- H. ANSI/InfoComm 10:2013 – Audiovisual Systems Performance Verification.
- I. ANSI/AVIXA V202.01:2016 – Display Image Size for 2D Content in Audiovisual Systems.

- J. ANSI/InfoComm 3M-2011 – Projected Image System Contrast Ratio.
- K. IBC – International Building Code.
- L. IEC – International Electrotechnical Commission.
- M. NFPA 70 – National Electric Code (NEC).
- N. UL 813 – Commercial Audio Equipment.
- O. UL 1419 – Professional Video and Audio Equipment.
- P. UL 1480 – Speakers for Fire Alarm, Emergency, and Commercial and Professional Use.
- Q. UL 1492 – Audio/Video Products and Accessories.

1.07 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 27 05 00.
- B. General Requirements:
 - 1. Submittals will be submitted in multiple passes over the course of construction. Each pass will be a dedicated single submission for review as outlined in the general submittal requirements outlined in section 270500.
 - 2. Should the Contractor not provide shop drawings in a timely fashion, not complete requirements, or extend the time of any resubmittals so as to jeopardize schedules, cause delay, or limit access for field work, the Contractor bears responsibility for impact and delay that may occur. This includes access or lift to overhead positions and associated protection of work already in place.
- C. First Pass Submittals: To be submitted after the project is awarded but before equipment is submitted, purchased and installed.
 - 1. Contractor(s) resume of qualifications.
 - 2. All certifications shall be current and valid. Any certificate with expired dates will not be accepted.
 - 3. All applicable AudioVisual and Integrated Experience Association (AVIXA) certifications. Qualifications from InfoComm that have not expired will be accepted.
 - 4. All certifications outlined in the qualifications shall be included in this submittal. Refer to the qualifications section for additional information. Certifications include, but are not limited to:
 - a. All installed manufacturer certifications required by the manufacturer.
 - b. Control system authorized dealer certification.
 - c. Control system certified programmer certification(s).
 - d. Audio system DSP dealer certification.
 - e. Audio system DSP programmer certification.
 - f. Video system dealer certification(s).
 - g. All other applicable dealer, installation, and programming certifications.
 - h. All applicable networking certifications.
 - 5. Audio and video calibration equipment certifications.
 - 6. Audio and video testing and calibration equipment and software procedures and manufacturer-specific equipment calibration certificates.
- D. Second Pass Submittals: To be submitted after all initial submittals have been approved but before equipment is purchased, installed, configured, and programmed. This can be submitted with the first pass submittal but will require to be submitted as a separate document.
 - 1. Product Data: Provide manufacturer's technical product specification sheet for each individual component type. Submitted data shall show the following:
 - a. Compliance with each requirement of these documents
 - b. All component options and accessories specific to this project.
 - c. Electrical power consumption rating and voltage.
 - d. Wiring requirements.
 - e. Pre-terminated cable distances and requirements identified by each room where required.

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- f. Product manuals are not an acceptable format and will be rejected.
- E. Final Pass Submittals: To be submitted after all initial submittals have been approved but before the equipment is installed, configured, and programmed. These should not be submitted until after the pre-installation meeting outlined in Part 3.
1. System Drawings: Project-specific system drawings shall be provided as follows:
 - a. Provide a system block diagram noting system components and interconnection between components. The interconnection of components shall clearly indicate all wiring required in the system. When multiple pieces of equipment are required in the exact same configuration (e.g., multiple identical controllers), the diagram may show one device and refer to the other as "typical" of the device shown.
 - b. Submittals shall contain shop drawings indicating physical plan locations and placement of installed devices and accessories with associated scope or field conditions for review and coordination. Provide mounting details, suspensions, and rough-in notes with trade demarcations.
 - 1) Identify any non-standard back boxes or mounting assembly required by product or specifications and elaborate contractor means and methods for mounting, provide rack drawing(s) showing the mounting of equipment in each rack or cabinet on the project.
 - 2) Provide rack drawing(s) showing the mounting of equipment in each rack or cabinet on the project.
 - 3) All display mounts shall be coordinated with the Architect to verify the exact vertical and horizontal positioning of the display. Coordinate in-wall stud locations for installation of recessed display mounts to install in the exact location as coordinated with the architectural drawings.
 - 4) Projector mounts shall be coordinated with other utilities on the ceiling and wall to minimize any potential obstructions for the visual beam of the projector prior to installation of the projector mount.
 - 5) Projector mounts, projector screens, recessed ceiling speakers, in-ceiling microphones, and all other above ceiling devices shall be coordinated with other trades in the field (e.g., mechanical ductwork, lights, diffusers, etc.) to minimize changes that will impact the performance of the system design.
 - c. Submit wiring and cable path requirements, including field wiring, path verification, signal separation, and outside diameter of cables for conduit sizing and verification that can be used for field installation and electrical coordination.
 - d. Reproduction of contract documents is not acceptable for submittals. Wire CAD type drawings and cable tag lists or schedules, or typical manufacturer's abbreviated single lines alone, are not complete.
 2. The contractor shall submit graphic or emulated representations of the control system touch panels for each unique space and layout prior to purchase, installation and programming for review and comment by the Architect/Engineer and Owner. These shall show and describe the intended programming/macro control features and functions of each button/icon for all pages.
 3. The contractor shall submit graphic or emulated representations of the control system keypads for each unique space and layout prior to purchase, installation and programming for review and comment by the Architect/Engineer and Owner. These shall show and describe the intended programming/macro control features and functions of each button/knob.
 4. The contractor shall submit the actual DSP audio processor files or single line audio path file diagram prior to installation for review and comment by the Architect/Engineer. Provide preliminary settings with processor blocks identified and note resources allocated.
 5. The contractor shall submit the number of IP addresses, VLANs, and subnetworks that will be required from the Owner's Information Systems Department.
 6. Submit meeting agenda for planning/programming meetings as required in Part 3 of this specification.
 7. Submit detailed description of Owner training to be conducted at project end, including specific training times and typical attendees expected.
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8. Provide rack drawing(s) showing of the mounting of equipment in each rack or cabinet on the project. Rack drawings shall include the following:
 - a. Equipment placement including mounting on the front or rear of the rack.
 - b. Spacing separation as required by equipment for adequate airflow and heat dissipation.
 - c. Signal separation based on AVIXA standards as required by the design.
 - d. Heating/cooling load requirements for submitted equipment to verify the heating/cooling load of the rack. This shall include Owner-provided equipment coordinated with the Owner.
 - e. Power requirements for each rack including plug type and loads based on the final approved products.
- F. Discontinued Products and New Model Releases:
 1. For each product, the Contractor shall submit (in addition to the specified product) a product cut sheet of the specified product has been replaced, improved upon, phased out or otherwise upgraded at the time of show drawing submittal.
 - a. The intent of this requirement is for the Contractor to submit only direct replacements for the specified products. A direct replacement shall be defined as a product of newer release that has equal or greater capabilities, which is available for not more than a 10% premium over the specified product's bid unit cost. The Contractor shall submit a letter from the manufacturer with a direct replacement that includes both model numbers to clarify the replacement.
 - b. It is not the intent of this requirement for the Contractor to submit new products or other product options that significantly differ in capabilities and/or cost from the specified product.
- G. Coordination Drawings:
 1. Include all ceiling-mounted devices in composite electronic coordination files. Refer to Section 27 05 00 for coordination drawing requirements.

1.08 SYSTEM DESCRIPTION

- A. This specification section describes the furnishing, installation, commissioning and programming of audio/video components and systems.
- B. Performance Statement: This specification section and the accompanying Contract Documents are performance based, describing the minimum material quality, required features, and operational requirements of the system. These documents do not convey every wire that must be installed, every equipment connection that must be made and every feature and function that must be programmed and configured. Based on the equipment constraints described and the performance required of the system, as presented in these documents, the Vendor and the Contractor are solely responsible for determining all wiring, programming and miscellaneous equipment required for a complete and operational system.
- C. This document describes the major components of the system. All additional hardware, subassemblies, supporting equipment and other miscellaneous equipment required for proper system installation and operation shall be provided by the Contractor.
- D. This document describes the major programming features and functions of the system. All additional programming, configuration and integration required for proper system installation and operation shall be provided by the Contractor.
- E. When a specific manufacturer is not provided in this document for minor pieces of equipment, the Contractor shall provide only those materials considered to be of the same industry commercial and professional quality level as the major equipment manufacturers.
- F. General System Description:
 1. System functions are covered in: Section 27 41 16; Section 27 51 16; and Section 27 51 23.

2. For integrated audio-visual systems where public events will be held: PTZ cameras, Dante-enabled audio components that are compatible with Dante Domain Manager, equipment to convert presentation content to SDI, and SDI-over-fiber transport equipment be installed to allow for the City of Madison IT Media Team to record, stream, and broadcast.

1.09 LICENSING REQUIREMENTS

- A. All user licenses required for system operation shall be included in the Contractor's bid. User licenses shall include, but not be limited to, server and workstation software and any other licensing that is required by the manufacturer for operation of any system component.
 1. Licenses shall be provided on a one-to-one basis. One license shall be provided for each server, workstation, and device requiring a license. In the event the manufacturer requires the purchase of a block of licenses, the minimum standard licensing package to support all devices shall be provided.

1.10 INTELLECTUAL PROPERTY OWNERSHIP

- A. All supporting documentation, programming, uncompiled source code, graphic files, DSP code and diagrams, written and electronic files, including all latest versions of the documentation and software necessary to edit and adapt the system{s}, shall be provided to and owned by the City of Madison for all spaces and all systems. The integrator and/or programmer shall also maintain a current copy to be provided at the Owner's request.
 1. Vendor may request source code from existing City of Madison systems.
 2. The City of Madison shall have the right to modify the intellectual property directly, or to have the intellectual property modified by any party of the Owner's choosing.

1.11 PROJECT RECORD DOCUMENTS

- A. Submit documents under the provisions of Section 27 05 00.
- B. Provide all applicable certifications.
- C. Provide statement that system checkout test, as outlined in the shop drawing submittal, is complete and satisfactory.
- D. Provide schedules documenting all terminal block wiring, including cable numbers.
- E. Warranty: Submit written warranty and complete all Owner registration forms.
- F. Complete all operation and maintenance manuals as described below.
- G. The Contractor shall include all factory-provided test results for equipment installed on the project.
- H. The Contractor shall include all test results from system demonstration and performance testing specified in this Document.
- I. Record Drawings shall minimally include:
 1. All revisions to, or deviations from the original drawings, as well as final dimensions, cable routes, connector panel drawings, cable numbering charts, and control system programming documentation. A complete as-installed equipment list, listed by room, and with manufacturers' names, model numbers, serial numbers, and quantities of each item.
 2. A complete and correct system schematic, showing detailed connections for all parts of the system, including wire numbers, terminal block numbers and layouts, and other designations and programming code.
 3. Complete equipment rack layouts showing locations of all rack-mounted equipment items.
 4. Additional information, diagrams or explanations as designated under respective equipment or system specification section.
 - a. Within each equipment room, the appropriate floor plan for which that equipment room serves shall be laminated and mounted for use by the Owner. Functional drawings shall be posted at each AV closet or included at every AV rack within a room.

- b. Upon completion and final acceptance of the project, the Contractor shall provide the Owner a copy of the programming code for any and all AV systems and devices programmed by the Contractor.
5. For any subsequent modifications to the programming code, an updated copy of the code shall be provided to the Owner.

1.12 OPERATION AND MAINTENANCE DATA

- A. See Section 01 33 23 – Submittals for City of Madison required submittal procedures.
- B. Manuals: Final copies of the manuals shall be delivered after completing the installation. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of the Contractor responsible for the installation and maintenance of the system and the factory representatives for each item of equipment for each system. The manuals shall have a table of contents and labeled sections. The final copies delivered after completion of the installation shall include all modifications made during installation checkout, and acceptance. Manuals shall be submitted in electronic format. The manuals shall consist of the following:
 1. Functional Design Manual: The functional design manual shall identify the operational requirements for the system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included.
 2. Hardware Manual: The manual shall describe all equipment furnished including:
 - a. General description and specifications.
 - b. Installation and checkout procedures.
 - c. Equipment layout and electrical schematics to the component level.
 - d. System layout drawings and schematics.
 - e. Alignment and calibration procedures.
 - f. Manufacturers repair parts list indicating sources of supply.
 3. Software Manual: The software manual shall describe the functions of all software and shall include all other information necessary to enable proper loading, testing, and operation. The manual shall include:
 - a. Definition of terms and functions.
 - b. System use and application software.
 - c. Initializations, startup, and shutdown.
 - d. Reports generation.
 - e. Details on forms customization and field parameters.
 4. Operator's Manual: The operator's manual shall fully explain all procedures and instructions for the operation of the system including:
 - a. Computers and peripherals.
 - b. System startup and shutdown procedures.
 - c. Use of system, command, and applications software.
 - d. Recovery and restart procedures.
 - e. Use of report generator and generation of reports.
 - f. Data entry.
 - g. Operator commands.
 - h. Alarm messages and reprinting formats.
 - i. System permissions functions and requirements.
 5. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
- C. Audio Calibration Data: Provide documentation on all EQ settings, crossover points, limiter settings, gate settings and all other applicable settings.

- D. Intellectual Property Ownership: Provide all uncompiled source code and DSP programming for all systems and spaces as described in Part 3 of this specification section. The City of Madison shall own the uncompiled source code.

1.13 WARRANTY

- A. Unless otherwise noted, provide warranty for one (1) year after Date of Substantial Completion for all materials and labor.
- B. Onsite Work During Warranty Period: This work shall be included in the Contractor's bid and performed during regular working hours, Monday through Friday.
1. Inspections: The Contractor shall perform two (2) minor inspections at even intervals (or more often if required by the manufacturer), and two (2) major inspections offset equally between the minor inspections.
 2. Minor Inspections: These inspections shall include:
 - a. Visual checks and operational tests of all equipment, field hardware, and electrical and mechanical controls.
 - b. Mechanical adjustments if required on any mechanical or electromechanical devices.
 3. Major Inspections: These inspections shall include all work described under paragraph Minor Inspections and the following work:
 - a. Clean all equipment, including filters, interior and exterior surfaces.
 - b. Perform diagnostics on all equipment.
 - c. Check, test, and calibrate any sensors or other equipment that contain settings.
 - d. Check zoom and focus of all projectors.
 - e. Run all system software diagnostics and correct all diagnosed problems.
- C. Operation: Upon the performance of any scheduled adjustments or repairs, Contractor shall verify operation of these systems.
- D. Emergency Service: The Owner will initiate service calls when the systems are not functioning properly. Qualified personnel shall be available to provide service within the distance defined within this specification section. The Owner shall be furnished with telephone number(s) where service personnel can be reached 24/7/365. Service personnel shall be at site within 24 hours after receiving a request for service.
- E. Records and Logs: The Contractor shall keep records and logs of each task completed under warranty. The log shall contain all initial settings at substantial completion. Complete logs shall be kept and shall be available for review on site, demonstrating that planned and systematic adjustments and repairs have been accomplished for the systems.
- F. Work Requests: The Contractor shall separately record each service call request on a service request form. The shall include the model and serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing what must be done, the amount and nature of the materials used, the time and date work started, and the time and date of completion. The Contractor shall deliver a record of the work performed within five (5) business days after work is accomplished.
- G. System Modifications: The Contractor shall make any recommendations for system modification in writing to the Owner. No system modifications shall be made without prior approval of the Owner. Any modifications made to the system shall be incorporated into the operations and maintenance manuals, and other documentation affected. To the fullest extent possible, the Owner shall be provided with electronic restorable versions of all configurations prior to the modifications being made.
- H. Software: The Contractor shall provide all software and firmware updates during the period of the warranty and verify operation of the system upon installation. These updates shall be accomplished in a timely manner, fully coordinated with system operators, shall include training for the new changes/features, and shall be incorporated into the operations and maintenance manuals, and software documentation.

- I. Refer to the individual product sections for further warranty requirements of individual system components.

1.14 ANNUAL SERVICE CONTRACT

- A. Provide annual cost for extended service and maintenance warranty after the first year for the audio/video systems according to the following terms:
 1. The term of the warranty shall begin on the system acceptance date and shall continue for one (1) year. The extended service and maintenance warranty may begin following this first year if accepted by the Owner. The term may be automatically renewed for successive one-year periods unless canceled by the Owner. The service and maintenance agreement shall include the following basic services to the Owner, including all necessary parts, labor and service equipment:
 - a. Repair or replace any equipment item that fails to perform as initially installed, as specified, or as determined per the manufacturer's performance criteria.
 - b. Perform semi-annual preventive maintenance on the equipment. This preventive maintenance shall include, but is not limited to, cleaning, realignment, filter cleaning and replacement, inspection, re-calibration, and testing of devices. The Owner shall receive a written report of these inspections that identifies the device's status and, if required, a list of all necessary repairs or replacements.
 - c. Provide software and firmware maintenance on the system. Contractor shall install and configure any software and firmware updates that the manufacturer provides at no cost. Any additional software or firmware options, updates, or enhancements purchased by the Owner shall be installed. The Contractor shall not be responsible for the purchase of additional software packages or the maintenance of Owner data.
 2. The Contractor shall be compensated for any repairs or maintenance provided as a result of Owner abuse, misuse, intentional damage, accidental damage, or power fluctuations exceeding specified equipment tolerances.
 3. System defects or failures shall be corrected within four (4) hours on the same business day if the Owner makes a service request before 11:00 am, or before 12:00 noon the next business day if the Owner makes the request after 11:00 am. If requested by the Owner, the Contractor shall respond or remain at the site after normal business hours, and the Owner shall reimburse the Contractor for the incremental cost difference between premium labor rates and standard labor rates. This reimbursement applies to premium labor rates that do not exceed time-and-one-half rates after normal business hours and double-time rates for Sundays and holidays. The Contractor's services shall be performed in a good and workmanlike manner and remain free from defects for a period of one (1) year.
- B. Provide complete terms and conditions of warranty and service.
- C. The Owner will enter into a contract directly with the vendor. This specification is not a contract between the Owner and the vendor to perform these services.

PART 2 - PRODUCTS

2.01 SYSTEM COMPONENTS

- A. Refer to the project drawings for basis of design system components. Equivalent products shall meet or exceed all requirements defined on the project drawings. The following product information represents the minimum additional requirements for equivalent products:
- B. Audio/Video GUI Control Systems:
 1. Contractor shall furnish a programmable software-based audio/video control system. The system shall be field configurable and programmable by the factory and/or a factory-trained programmer.
 2. The control system shall be TCP/IP based allowing direct connection of the system processors to a 10/100BaseT compatible Ethernet network.

3. Vendor shall configure and program all Crestron components so that they can be monitored and controlled by Crestron Fusion. Vendor shall provide X-Panels of all touch panels that can be accessed by Crestron Fusion.
- C. Microphone Systems:
1. Wireless Microphones:
 - a. Wireless microphones shall not operate in the 516 to 865 MHz band (channels 38 to 69).
 - b. Features:
 - 1) Dual antenna reception with true diversity reception.
 - c. Microphone systems that are common {shared} by multiple spaces or when the receivers are in a remote area shall include a compatible wireless antenna distribution system by the same manufacturer as the wireless microphone system.
- D. Audio Amplifiers:
1. Power Amplifier(s), 25, 70.7 and 100 Volt:
 - a. Power: The following calculation shall be used to determine the minimum required output of the amplifier{s}:
 - 1) Calculate the total power tap value of each transformer with insertion loss using the following equation:
(a) $\text{Tap wattage} \times 10A(\text{xdB}/10)$ where x = the rated insertion loss at 1,000Hz.
 - 2) Calculate the total wattage loss based on cable distance, cable gauge and cable resistance.
 - 3) Add together all the speaker taps' total power values that will be on a single channel of the amplifier. Multiply that total by 1.2, which will allow for a 20% future expansion. Multiply that number by 1.25 to ensure the amplifier never exceeds 75% of its total output. Utilize the final number to determine the minimum amplifier power requirements.
- E. Assisted Listening Systems (ALS):
1. Assisted listening requirements for this project shall follow the local jurisdiction's requirements to quantify the number of devices for use on this project.
 2. All spaces with amplified audible communications require an ALS. The Contractor shall refer to the ADA and ADAAG guidelines, as well as IBC Section 1108.2.7 for ALS rules, regulations and guidelines. Refer to the table below for the required number of receivers to be provided for each space (Source: IBC, Table 1108.2.7.1). Alternatively, if the building is managed by a single entity and all systems are fully compatible and interoperable, the total number of seats for all areas can be used in accordance with the table below:

Capacity of Seating in Assemble Areas	Minimum Required Number of Receivers	Minimum Number of Receivers to be Hearing-aid (T-coil) Compatible
50 or less	2	2
51 to 200	2, plus 1 per 25 seats over 50 seats	2
201 to 500	2, plus 1 per 25 seats over 50 seats	1 per 4 receivers
501 to 1,000	20, plus 1 per 33 seats over 500 seats	1 per 4 receivers
1,101 to 2,000	35, plus 1 per 50 seats over 1,000 seats	1 per 4 receivers
Over 2,000	55, plus 1 per 100 seats over 2,000 seats	1 per 4 receivers

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3. Receivers required to be hearing-aid compatible shall interface with telecoils in hearing aids through the provision of neckloops and shall be over-the-ear type headphones. Earbuds are not acceptable for this use.
 4. Receivers shall include a 1/8" (3.2mm) standard mono output jack.
 5. Refer to the Access Board Research "Large Area Assistive Listening Systems: Review and Recommendations" ALS report for additional recommendations.
- F. Power Conditioning and Surge Protective Devices:
1. All equipment shall be plugged in through a power conditioning surge arrestor.
 2. Provide a minimum of 50 dB noise attenuation.
 3. Provide a minimum of 1,500 joules of surge protection.
 4. UL 1449 Standard for Safety for Surge Protective Devices listed to 330 volt clamping voltage.
 5. Refer to the project drawings for additional information.
- G. Digital Video Signal Equalizers and Regenerators:
1. For any cable run that exceeds the manufacturer-recommended distances or fails to transmit video or audio due to cable length, the Contractor shall provide and install a signal equalizer at the far end {sink} with the following minimum features:
 - a. HDMI/DVI equalizers shall be HDCP compliant and support actively buffered DDC transmission.
 - b. Display port equalizers shall be HDCP and DPCP compliant, support actively buffered DDC transmission, and be DP+ compatible.
 - c. Provide automatic equalization.
 - d. Pass all embedded audio and metadata.
 - e. Have an auxiliary power input when adequate power is not available on the cable.
 - f. Provide output reclocking and jitter reduction for multi-rate SDI signals.
 2. For any cable run that fails to transmit video or audio due to a weak source signal, the Contractor shall provide and install a signal regenerator at the near end {source} with the following minimum features:
 - a. HDMI/DVI regenerators shall be HDCP compliant and support actively buffered DDC.
 - b. Display port regenerators shall be HDCP and DPCP compliant, support DDC transmission, and be DP+ compatible.
 - c. Provide automatic output reclocking and jitter reduction.
 - d. Pass all embedded audio and metadata.
 - e. Have an auxiliary power input when adequate power is not available on the cable.
- H. Extended Display Identification Data (EDID) Emulators:
1. If any source or Owner-furnished equipment (OFE) is not outputting video properly, the Contractor shall provide and install an EDID Emulator and set it to the highest common EDID table of the displays (sinks) being outputted to, with the following minimum features:
 - 1) EDID capture mode from a display.
 - 2) Have an auxiliary power input when adequate power is not available on the cable.
- I. Audio Unbalanced to Balanced Converters, Balanced to Unbalanced Converters, Combiners, Dividers, Isolation Transformers, and Line Drivers Minimum Requirements:
1. Unbalanced to Balanced Active Converter:
 - a. Provide signal isolation from the audio signals of differing channels.
 - b. Provide output trim gain and set to optimal output level while preventing over amplification and clipping of the signal.
 - c. Minimum frequency response of 20 Hz to 20 kHz ($\pm 0.5\text{dB}$).
 - d. Provide with appropriate power supply and mounting kit for rack or wall use.
 - e. Provide appropriate converter for mono to mono, mono to stereo, stereo to stereo, or stereo to mono to match the input of the equipment to which it is being connected.
 2. Balanced to Unbalanced Passive Converter:
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- a. Provide transformer isolation from the input to output.
 - b. Provide output trim attenuation and set to optimal output level while preventing over-amplification and clipping of the signal.
 - c. Minimum frequency response of 20 Hz to 20 kHz ($\pm 0.5\text{dB}$).
 - d. Provide with appropriate mounting kit for rack or wall use.
 - e. Provide appropriate converter for mono to mono, mono to stereo, stereo to stereo, or stereo to mono to match the input of the equipment to which it is being connected.
- J. Refer to project drawings for all other equipment not listed.

2.02 AUDIO CONNECTORS

- A. This article includes minimum requirements for all connectors that are acceptable on this project. Should the Contractor request an alternative connector, it shall be submitted with the product submittals and clearly identified with which connector it will be replaced.
- B. XLR Jack:
- 1. Panel Mount: Professional grade, crimped insert for vibration control, nickel shell, silver pins, pin quantity as required for application.
 - 2. Manufacturers:
 - a. Switchcraft.
 - b. Neutrik.
 - c. Mogami.
- C. XLR Plug:
- 1. Professional grade, 360° strain relief, nickel shell, silver pins. Provide colored boot.
 - 2. Manufacturers:
 - a. Switchcraft.
 - b. Neutrik.
 - c. Mogami.
- D. Loudspeaker Connector:
- 1. Panel Mount: Twist-lock type, 4-conductor.
 - 2. Manufacturers:
 - a. Neutrik.
 - b. Speakon.

2.03 AUDIO CABLING

- A. Refer to Section 27 05 00 for cable rating requirements.
- B. Microphone Level Audio Cabling:
- 1. For patch cables less than or equal to 25 feet (762 cm):
 - a. 24 AWG 2-conductor, twisted, stranded (19x36) tinned bare copper.
 - b. Single Layer Shield:
 - 1) Shield: 100% aluminum foil shield.
 - c. Nominal Capacitance: 30.0 pF/Ft.
 - 1) Belden.
 - 2) West Penn.
 - 3) Liberty.
 - 2. For cable runs greater than or equal to 25 feet (762 cm):
 - a. 22 AWG 2-conductor, twisted, stranded (16x34) tinned bare copper.
 - b. Dual Layer Shield:
 - 1) Shield: 85% total tinned copper braid shield.
 - c. Nominal Capacitance: 18.0 pF/Ft.
 - d. Manufacturers:
 - 1) Belden.
 - 2) West Penn.

- 3) Liberty.
- (a) C. Line Level Audio Cabling:
3. For patch cables less than or equal to 25 feet (762 cm):
 - a. 22 AWG 2-conductor, twisted, stranded (7x30) tinned bare copper.
 - b. Single Layer Shield:
 - 1) Shield: 100% aluminum foil shield.
 - c. Nominal Capacitance for non-plenum cable: 24.0pF/Ft.
 - d. Nominal Capacitance for plenum cable: 35.0 pF/Ft.
 - e. Manufacturers:
 - 1) Belden.
 - 2) West Penn.
 - 3) Liberty.
4. For cable runs greater than or equal to 25 feet (762 cm):
 - a. 18 AWG 2-conductor, twisted, stranded (16x30) tinned bare copper.
 - b. Single Layer Shield:
 - 1) Shield: 100% aluminum foil shield.
 - c. Manufacturers:
 - 1) Belden.
 - 2) West Penn.
 - 3) Liberty.
- C. Constant Voltage Speaker Cabling:
 1. Class 2, stranded, twisted, 2-conductor, minimum of 16-gauge wire for all 25/70.7/100-volt applications unless noted otherwise.
 2. The Contractor shall size cabling as required for distance power and shall provide larger gauge cable required.
 3. Manufacturers:
 - a. Belden.
 - b. Liberty.
 - c. Or pre-approved equal.

2.04 DIGITAL VIDEO CABLING

- A. All digital video cabling shall be pre-assembled and tested in a factory and not field terminated. The contractor shall field verify the cable distance and provide the proper cable type and length.
- B. High-Definition Multi-Media Interface (HDMI) "High Speed" Cable:
 1. For any cable run that exceeds the manufacturer-recommended distances or fails to transmit video or audio due to cable length, the Contractor shall provide and install an HDCP-compliant signal equalizer at the far end (sink).
 2. Provide HDMI cabling meeting HDMI 2.0 standards or greater:
 - a. HDCP compliant.
 - b. Manufacturers:
 - 1) Belden.
 - 2) Or pre-approved equal.
 3. Cabling Requirements:
 - a. All HDMI extension cabling must be manufacturer-approved and specifically designed for HDMI extension purposes.
 - b. Cables should meet or exceed industry standards for HDMI transmission, including but not limited to HDMI 2.0 or higher.
 - c. The length of the cables must be appropriate for the specific requirements of the project, with options for various lengths to accommodate different installation scenarios.
 - d. Cables must be capable of supporting high-definition video resolutions (e.g., 4K, 8K) and audio formats (e.g., Dolby Atmos, DTS).

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4. Manufacturer Approval:
 - a. The contractor must provide documentation demonstrating that the selected HDMI extension cables are approved by the manufacturer of the HDMI equipment being used in the project.
 - b. Only cables from reputable manufacturers with a proven track record of reliability and performance should be considered.
 5. Installation Guidelines:
 - a. Cables must be installed according to the manufacturer's recommended guidelines to ensure optimal performance and longevity.
 - b. Proper cable management techniques should be employed to minimize interference and maintain signal integrity.
 6. Testing and Certification:
 - a. Upon completion of the installation, the contractor is responsible for testing the HDMI extension system to verify proper functionality.
 - b. Any issues or deficiencies discovered during testing must be promptly addressed and resolved to the satisfaction of the project owner.
 7. Bid Submission Requirements: Contractors submitting bids for this project must include the following documentation:
 - a. Detailed description of the proposed HDMI extension cabling, including manufacturer name, model numbers, and specifications.
 - b. Proof of manufacturer approval for the selected cables.
 - c. Proposed installation plan outlining how the cables will be deployed and managed.
 - d. Total cost estimate for the supply and installation of the HDMI extension cabling.
- C. Display Port Cable:
1. For any cable run that exceeds the manufacturer-recommended distances, the Contractor shall provide and install an HDCP and DPCP compliant signal equalizer at the far end (sink).
 2. Supports a maximum digital data rate of 8.64 Gbit/s.
 3. Supports HDCP and DPCP.
 4. Manufacturers:
 - a. Blue Jeans Cable.
 - b. Or pre-approved equal.
- D. High-Definition Serial Digital Interface (HD-SDI) Cabling:
1. For patch cables less than or equal to 25 feet (762 cm):
 - a. RG-59, center conductor: 22 AWG stranded (7x29) bare copper, 0.023" OD {nominal}, polyethylene dielectric.
 - b. Single Layer Shield:
 - 1) Outer Shield: 98% tinned copper braid.
 - c. Nominal Impedance: 75 ohms.
 - d. Nominal Capacitance: 21.0 pF/Ft.
 - e. Velocity of Propagation: 66%.
 - f. Maximum Attenuation {per 100 feet (3048 cm):
 - 1) at 1-MHz: 0.3 dB.
 - 2) at 71.5-MHz: 2.5 dB.
 - 3) at 360-MHz: 6.0 dB.
 - 4) at 750-MHz: 8.9 dB.
 - 5) at 1000-MHz: 10.5 dB.
 - g. Manufacturers:
 - 1) Belden.
 - 2) CommScope.
 - 3) Liberty.
 - 4) Extron.
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2. For horizontal cable runs less than or equal to 100 feet (3048 cm):
 - a. RG-59, center conductor: 20 AWG solid bare copper, 0.031" OD (nominal), FEP insulation.
 - b. Double Layer Shield:
 - 1) Outer Shield: 95% tinned copper braid outside and bonded foil inside.
 - c. Nominal Impedance: 75 ohms.
 - d. Nominal Capacitance: 16.1 pF/Ft.
 - e. Velocity of Propagation: 83%.
 - f. Maximum insertion loss per 100 feet (3048 cm):
 - 1) at 1-MHz: 0.3 dB.
 - 2) at 71.5-MHz: 2.1 dB.
 - 3) at 360-MHz: 4.4 dB.
 - 4) at 750-MHz: 6.5 dB.
 - 5) at 1000-MHz: 7.6 dB.
 - g. Manufacturers:
 - 1) Belden non-plenum or plenum.
 - 2) CommScope.
 - 3) Liberty.
 - 4) Extron.
 3. For horizontal cable runs greater than or equal to 100 feet (3048 cm):
 - a. For any cable run that exceeds the manufacturer-recommended distances or fails to transmit video or audio due to cable length, the Contractor shall provide and install a signal equalizer at the far end (sink).
 - b. RG-6, center conductor: 18 AWG solid bare copper, 0.274" OD (nominal).
 - c. Double Layer Shield:
 - 1) Inner Shield: 100% non-bonded aluminum foil tape.
 - 2) Outer Shield: 95% tinned copper braid.
 - d. Nominal Impedance: 75 ohms.
 - e. Nominal Capacitance: 15.9 pF/Ft.
 - f. Velocity of Propagation: 84.5%.
 - g. Maximum attenuation for non-plenum cable {per 100 feet (3048 cm):
 - 1) at 1-MHz: 0.2 dB.
 - 2) at 71.5-MHz: 1.6 dB.
 - 3) at 360-MHz: 3.5 dB.
 - 4) at 750-MHz: 5.1dB.
 - 5) at 1000-MHz: 5.9 dB.
 - h. Manufacturers:
 - 1) Belden.
 - 2) CommScope.
 - 3) Liberty.
 - 4) Extron.

2.05 TRANSMISSION CABLING

- A. For patch cables less than or equal to 25 feet (762 cm):
 1. RG-174, center conductor: 26 AWG stranded (7x34) copper-covered steel; 0.019" OD {nominal}; polyethylene insulation.
 2. Single Layer Shield:
 - a. Outer Shield: 90% tinned copper braid shield.
 3. Nominal Impedance: 50 ohms.
 4. Nominal Capacitance: 30.8 pF/Ft.
 5. Velocity of Propagation: 66%.
 6. Maximum Attenuation {per 100 feet (3048 cm):
 - a. at 1-MHz: 1.9 dB.

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- b. at 50-MHz: 5.8 dB.
 - c. at 400-MHz: 19.0 dB.
 - d. at 700-MHz: 27.0 dB.
 - e. at 1000-MHz: 34.0 dB.
 - 7. Cable shall be installed in conduit within plenum areas.
 - 8. Manufacturers:
 - a. Belden.
 - b. CommScope.
 - c. Liberty.
 - d. Times Fiber.
- B. For horizontal cables less than or equal to 50 feet (1524 cm):
- 1. RG-58, center conductor: 20 AWG bare solid copper; 0.037" OD {nominal}; polyethylene insulation for non-plenum and FEP Teflon dielectric for plenum.
 - 2. Single Layer Shield:
 - a. Outer Shield: 95% tinned copper braid shield.
 - 3. Nominal Impedance: 50 ohms.
 - 4. Nominal Capacitance for non-plenum cable: 28.5 pF/Ft.
 - 5. Nominal Capacitance for plenum cable: 26.4 pF/Ft.
 - 6. Velocity of Propagation for non-plenum cable: 66%.
 - 7. Velocity of Propagation for plenum cable: 69.5%.
 - 8. Maximum attenuation for non-plenum cable per 100 feet (3048 cm):
 - a. at 1-MHz: 0.3 dB.
 - b. at 50-MHz: 2.5 dB.
 - c. at 400-MHz: 8.4 dB.
 - d. at 700-MHz: 11.7 dB.
 - e. at 1000-MHz: 14.5 dB.
 - 9. Maximum attenuation for plenum cable {per 100 feet (3048 cm):
 - a. at 1-MHz: 0.5 dB.
 - b. at 50-MHz: 3.0 dB.
 - c. at 400-MHz: 9.7 dB.
 - d. at 700-MHz: 13.7 dB.
 - e. at 1000-MHz: 17.3 dB.
 - 10. Manufacturers:
 - a. Belden plenum.
 - b. CommScope.
 - c. Liberty.
 - d. Times Fiber.
- C. For horizontal cables greater than or equal to 50 feet (1524 cm):
- 1. RG-8 center conductor: 10 AWG bare solid copper; 0.108" OD (nominal); foam HDPE insulation for non-plenum and foam FEP dielectric for plenum.
 - 2. Two Layer Shield:
 - a. Inner Shield: non-bonded aluminum foil tape.
 - b. Outer Shield: 90% tinned copper braid shield.
 - 3. Nominal Impedance: 50 ohms.
 - 4. Nominal Capacitance for non-plenum cable: 24.8 pF/Ft.
 - 5. Nominal Capacitance for plenum cable: 24.2 pF/Ft.
 - 6. Velocity of Propagation for non-plenum cable: 82%.
 - 7. Velocity of Propagation for plenum cable: 84%.
 - 8. Maximum attenuation for non-plenum cable per 100 feet (3048 cm):
 - a. at 1-MHz: 0.4 dB.
 - b. at 50-MHz: 1.0 dB.
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- c. at 400-MHz: 2.6 dB.
- d. at 700-MHz: 3.6 dB.
- e. at 1000-MHz: 4.4 dB.
- f. at 4000-MHz: 9.9 dB.
- 9. Maximum attenuation for plenum cable per 100 feet (3048 cm):
 - a. at 1-MHz: 0.1 dB.
 - b. at 50-MHz: 1.1 dB.
 - c. at 400-MHz: 3.2 dB.
 - d. at 700-MHz: 4.5 dB.
 - e. at 1000-MHz: 5.9 dB.
 - f. at 4000-MHz: 14.1 dB.
- 10. Manufacturers:
 - a. Belden non-plenum or plenum.
 - b. CommScope.
 - c. Liberty.
 - d. Times Fiber.

2.06 CONTROL CABLING

- A. Control:
 - 1. For Bidding Purposes: Two-pair, twisted, shielded, one (1) #18 AWG pair and one (1) #22 AWG pair. Provide with plenum-rated jacket where used in a plenum space without conduit.
 - 2. Size conductors as required for distance and voltage drop.
 - 3. Coordinate exact requirements with selected manufacturer and system prior to submitting bid.
- B. Other Control Circuits:
 - 1. #20 AWG, stranded, shielded cable, number of conductors as required for the applications. Provide with plenum-rated jacket where used in a plenum space without conduit. Provide PVC jacket where installed in conduit or non-plenum areas.
 - 2. Coordinate exact requirements with selected manufacturers prior to submitting bid.

2.07 HORIZONTAL COPPER DATA AND FIBER CABLING AND CONNECTORS

- A. Refer to Section 27 00 05 – Communications Cabling for telecommunications cabling and connector requirements, and testing, including fiber optics being utilized for A/V systems.
- B. All category-rated copper data cabling and fiber optic cabling shall be installed, terminated, tested, and certified by the Division 27 Telecommunications contractor certified by the selected manufacturers for the copper and fiber optic cabling plant. The Contractor shall submit all cabling and certifications to the Architect/Engineer for approval in the shop drawings.
- C. The A/V contractor shall coordinate purchase, installation, testing and certification with the telecommunication contractor for all required category-rated copper data cabling and fiber optic cabling required for A/V system operation prior to bid.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work.
- B. Verify field dimensions and coordinate physical size of all equipment with the architectural requirements of the spaces into which they are to be installed. Allow space for adequate ventilation and circulation of air.
- C. Verify that required utilities are available, in proper location, and ready for use.
- D. Beginning of installation means installer accepts existing conditions.

3.02 PRE-INSTALLATION

- A. A pre-installation meeting shall be held after the project has been awarded but before any submittals or work has been conducted. The purpose of this meeting is to review the drawings and specifications to assist with the construction and installation process that will occur during construction. The meeting will include the Engineer, Architect, Owner, and all relevant installing contractors for this system. The meeting will be chaired by the project manager for the AV contract and will include the following topics:
 - a. Describe system function by area and confirm user requirements are being met.
 - b. Discuss inconsistencies in plans or specs.
 - c. Discuss coordination issues anticipated.
 - d. Discuss lead time issues.
- B. The Contractor shall be responsible for submitting all requested submittals and holding the pre-installation meeting prior to any purchasing, installation, programming, and construction coordination. Any delays or changes to the project as a result of meeting this requirement will be at the Contractor's expense.

3.03 INSTALLATION

- A. Comply with the manufacturer's instructions and recommendations for installation of all products.
- B. Provide all system wiring between all components as directed by the manufacturer or required for proper system operation.
- C. Mount all touch screen and keypad devices where shown on plans in accordance with Americans with Disabilities Act (ADA) requirements for both side reach and front reach.
- D. Cabling Requirements:
 - 1. Non-plenum rated cabling may be used instead of plenum when installed with-in conduit in plenum rated areas.
 - 2. All cabling shall be routed according to function. Cabling shall be grouped and bundled by groups, such as microphone and line level audio, control, video and speaker. In no case shall cabling from different functional groups be intermixed. No cabling shall be routed parallel to 120 VAC or higher power circuits unless separated by a minimum of 6" and the 120 VAC or higher power is installed in conduit.
 - 3. When cabling is installed in conduit, a separate conduit shall be provided for each cabling functional type.
 - 4. Cable bundles shall be loosely bundled to allow the visual following of individual cables within the bundle and to permit the easy removal and addition of cables as necessary.
 - 5. Horizontal cabling installed as open cable or in cable tray shall be bundled at not less than 10' intervals with hook-and-loop tie wraps. The use of plastic cable zip ties is strictly prohibited in any situation.
 - 6. Cabling shall not be spliced under any circumstances.
 - 7. Each cable shall be appropriately identified {as defined on the record documents} at each end's termination point using pressure sensitive label strips.
 - 8. Audio Cabling:
 - a. All amplified audio cabling shall not be in the same enclosed pathway as any other type of cabling as required by the NEC. Refer to the NEC for definitions and additional requirements.
 - b. The polarity of all cabling shall remain consistent throughout the project, on all equipment. Red conductors shall be used for the positive "+" side, and black used for the negative "-" side.
 - c. Cable shield length shall be equal to the cable's conductor length.
 - d. All shielded cables drain wire SHALL be grounded and continuous throughout the entire length of the system, including splices where speakers are installed.
 - e. Balanced audio connections shall be used whenever the mating equipment allows.

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- f. Do not run unbalanced cables longer than 3m. For interconnecting of unbalanced equipment in lengths longer than 3m, the Contractor shall provide a line driver located at the source.
 - 9. Video Cabling:
 - a. All video cabling, unless otherwise noted, shall be provided with BNC connectors of the two-piece compression type. Twist-on BNC connectors are not permitted.
 - b. Provide BNC 75-ohm terminators where required for all open BNC connectors.
 - c. All coaxial video cables used for S-video, component/RGB and RGBHV shall be the same length to minimize skew.
 - 10. Twisted Pair Cabling for All Applications:
 - a. The Contractor shall ensure that the twists in each cable pair are preserved to within 0.5 inch (12.7 mm) of the termination. The cable jacket shall be removed only to the extent required to make the termination.
 - b. The Contractor shall ensure that the cable shields are continuous throughout, terminated, and grounded according to the manufacturer's recommendations.
 - E. Grounding Requirements:
 - 1. Provide a minimum of #6 AWG conductor from the nearest electrical service ground bus or nearest telecommunications room ground bus bar to the A/V equipment racks and cabinets regardless of location. Size cable as required by the NEC.
 - 2. Cables containing shields shall not have the shields grounded at conduits, boxes, racks, etc. Ground the shield only at the equipment end.
 - 3. Audio cable shields for line-level signals shall be connected to the metal equipment chassis at both ends of the cable.
 - 4. Audio cables connected to transformers shall have the cable shield connected to the transformer shield and transformer case ground.
 - 5. The Contractor shall not connect cable shields together from differing cables.
 - 6. XLR cable shields shall be connected to chassis ground.
 - 7. Signal-grounded balanced shields are not acceptable and shall not be installed. All balanced shields shall be chassis grounded.
 - F. Rack and Cabinet Requirements:
 - 1. Ground equipment racks/cabinets as noted within this specification section and Section 270526 - Communications Grounding.
 - 2. Provide one (1) RU of space between adjacent pieces of equipment with top and/or bottom vents, above the topmost piece of equipment, and below the bottommost piece of equipment. Provide a vented cover panel covering each rack space.
 - 3. Terminate all speaker cabling on individual barrier strips for positive "+", negative "-", and shield. The shield barrier strip shall be grounded.
 - 4. Provide a power conditioning surge arrestor in the rack for distribution of AC power from the wall receptacles indicated on the plans. The quantity of plugs shall be adequate so that no equipment in the rack shall require plugging into an AC source outside the rack.
 - 5. Power sequencing shall be provided in the racks where shown on the drawings. All amplifiers located in the racks shall be sequenced "last on - first off". Power sequencers shall provide power conditioning and surge protection.
 - G. Video System Installation Requirements:
 - 1. Video display image shall fill screen area with native aspect ratio.
 - H. Audio System Installation Requirements:
 - 1. The Contractor shall perform calculations for the optimal speaker tap settings to reach the desired SPL level and coverage without overloading the amplifier(s).
 - a. At a minimum, the following calculations shall be used:
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- 1) Add together all speaker taps that will be on a single channel of the amplifier. Multiply that total by 1.2, which will allow for a 20% future expansion. Multiply that number by 1.25 to ensure the amplifier never exceeds 75% of its total output. Utilize the final number to determine the minimum amplifier power requirements.
 - 2) For direct coupled systems (low impedance), allow a minimum of 10 dB headroom before any distortion occurs at the amplifier input indicator when beginning gain stage tests are set up. Increase headroom as appropriate for high impact and clarity needs, typically exceeding 12 to 15 dB during continuous operation.
2. Connections of balanced to unbalanced equipment shall only be done through an active converter at the unbalanced side.
 3. Connections of unbalanced to balanced equipment shall only be done through an active converter at the unbalanced side.
 4. Connections from stereo balanced or unbalanced equipment to mono equipment of the same signal type shall only be done through a passive combiner.
 5. Connections from mono balanced or unbalanced equipment to stereo equipment of the same signal type shall only be done through a passive divider.
 6. The Contractor shall provide an isolation transformer for any balanced or unbalanced audio line that exhibits a hum, noise from EMI or RFI, power line noise, or ground loops.
 7. The Contractor shall provide an active audio line driver for all balanced and unbalanced signals that exceed the distance limitations of the cabling.
- I. Control System Installation Requirements:
1. The Contractor shall perform calculations for the required wire AWG size based on distance for system power for touch panels, keypads and other devices being powered. A minimum of a 15% overhead is required.

3.04 VIDEO SYSTEM TESTING AND CALIBRATION

- A. All video equipment shall receive proper testing and configuration.
- B. Color Space Optimization:
1. The contractor shall set the color space of each source and display device to a uniform color space to optimize the switching speed and compatibility of a digital video system. Each device shall be set to an RGB or YCbCr color space depending on the systems primary function and compatibility of the devices.
 2. If the primary function of the space is video and other digital media, the color space of each device shall be set to a YCbCr color space. If the primary function of the space is computer-based graphics and presentations, the color space of each device shall be set to an RGB color space.
 3. Chroma subsampling shall be set to a consistent 4:4:4 or 4:2:2 across all devices. Set to 4:4:4 when all equipment is capable.
 4. If all devices are not capable of displaying a certain color space, all devices shall be set to a common shared color space.
- C. Extended Display Identification Data (EDID) Management:
1. The Contractor shall set the EDID management tables in capable equipment so all sources output the highest common EDID table of the displays (sinks).
 2. For systems with capable matrix switches, the matrix shall dynamically adjust its EDID tables so any source will output the highest common EDID table of the displays (sinks) being outputted to.
 3. If any source or Owner-furnished equipment (OFE) is not outputting properly, the Contractor shall provide and install an EDID Emulator and set it to the highest common EDID table of the displays (sinks) being outputted to.
- D. Projectors, monitors and receivers shall be tested and adjusted for proper signal sync, convergence, brightness, contrast, and color level. The Contractor shall adjust all other parameters necessary to achieve a proper video image.
- E. All video source selections shall be tested and verified.

- F. All projectors and displays shall have a minimum burn-in time of 96 hours prior to any adjustments are made and the completion of the project.
- G. All projectors and displays shall have their hue/tint and color/saturation calibrated with a video signal test generator and blue lens filter after a minimum warmup time of 20 minutes. Provide all calibrated settings results for each projector and display in the final documentation.
- H. All projectors and displays shall have their brightness, contrast and sharpness calibrated with a video signal test generator after a minimum warmup time of 20 minutes. Provide all calibrated settings results for each projector and display in the final documentation.
- I. All dynamic contrast functions shall be turned off.

3.05 AUDIO SYSTEM TESTING AND CALIBRATION:

- A. This Contractor shall field adjust any surface-mounted or flown loudspeaker orientation to achieve the necessary coverage pattern to the intended listening plane. Loudspeakers always face listeners and minimize coverage on walls. The contractor shall be familiar with the named and specified nominal coverage angle of all speakers above its crossover point or for speech range, (500-4,000 Hz).
- B. All speakers shall be tested for polarity prior to high work and a table of test results shall be included for A/E inspection. All loudspeakers shall be connected with uniform polarity, where a positive pressure pulse at the input corresponds to a positive driver excursion, and all drivers are uniform always moving in the same direction. Main speakers shall not be lifted or hoisted into high access areas without polarity testing.
- C. The Contractor shall make incremental adjustments on the equipment output and input tolerances to achieve matching signal levels while preserving +10 dB minimum headroom and also unity gain. Insert all broadband or high pass filters first for system protection after review of manufacturers specifications for power and bandpass.
- D. Provide high quality media with full bandpass program material for critical listening. MP3 or streaming audio is not acceptable. Testing shall illustrate WAV file quality playback for impact and clarity.
- E. The Contractor shall provide graphic plots of the reference ambient noise for each space at the time of the calibration and submit with the calibration results. Test signal shall be 10dB minimum above ambient noise levels during testing.
- F. The Contractor shall use a listener sitting height of four (4) feet \pm 1" for rooms where the primary function will be sitting. The Contractor shall use a listener standing height of five feet three inches (5.25') \pm 1" for rooms where the primary function will be standing.

3.06 ASSISTED LISTENING SYSTEM {ALS} PERFORMANCE REQUIREMENTS

- A. The Contractor shall verify that the ALS system(s) meets the following minimum performance requirements at the earphone or headset:
 - 1. Reach a minimum total SPL of 75 dBA and no greater than 95 dBA, with a minimum of a 50dB dynamic range volume control.
 - 2. Achieve a minimum signal-to-noise (S/N) ratio of 18dB. It is recommended to achieve a minimum signal-to-noise (S/N) ratio of 25dB to accommodate children.
 - 3. Ensure the peak clipping levels do not exceed 18dB down from the peak input signal level.
- B. FM-based systems shall operate within the FCC-reserved assisted listening frequencies of 72 to 76 MHz or the 216 to 217 MHz (preferred) range and comply with the FCC transmitter power requirements.

3.07 DSP-BASED AUDIO PROCESSOR PROGRAMMING

- A. Full system programming shall be provided for the system. Programming shall be performed by a factory trained and certified programmer or an employee of the equipment manufacturer.
- B. DSP pathfile with initial settings shall be provided by the Contractor for review by the Architect/Engineer before installation.

- C. The IP-based audio (Dante, etc.) and components shall be on a dedicated Virtual LAN (VLAN) for the A/V systems. These components shall be on a dedicated subnetwork of the VLAN. The Contractor shall coordinate these requirements with the Owner prior to installation.
- D. A parametric EQ shall be provided after each crossover point or as approved in the DSP pathfile during shop submittal review. These shall be utilized to set the speaker output as defined in the Audio System Calibration section within this specification. These equalizers should not be made available to the user to adjust.
- E. Levelers, compressor/limiters, duckers, gates and delays shall be preset during testing and commissioning and are not available for user adjustment following commissioning.
 - 1. Adjust delays for time of flight plus 8 to 10 ms, typical.
- F. Provide each microphone input with high-pass filter, 5-band parametric EQ, auto-leveler and volume module. Provide line level inputs with high-pass filter, 3-band parametric EQ, compressor/limiter, and volume module.
- G. Acoustic Echo Cancelation (AEC) shall be provided for each conference microphone input.
- H. A broadband pink noise generator shall be provided with a selectable on/off control button within the DSP pathfile. The noise shall be routable through all processing EQs and speaker outputs during testing.
- I. Provide volume meters with labeling for each input and each output.
- J. The Contractor shall utilize the latest version of the programming software.
- K. The Contractor shall ensure that all components are updated to the latest firmware at the completion of the project.

3.08 DSP-BASED AUDIO PROCESSOR CONTROL SOFTWARE PROGRAMMING

- A. Full system software programming shall be provided for the system. Programming shall be performed by a factory-trained and certified programmer or an employee of the equipment manufacturer.
- B. The Contractor shall schedule a series of meetings with the Owner and Architect/Engineer to define and determine the exact page layout requirements prior to the final configuration of the audio system. An Owner sign-off of the final layouts shall be required.
- C. The Contractor shall use the latest version of the software.
- D. At a minimum, there shall be password-protected pages for zone combining, input/output volume control with meters, speaker output volume control with meters, signal routing, signal processing (EQ's, feedback suppression, etc.), and supervision/maintenance for all spaces and combined zones.

3.09 MULTIMEDIA CONTROL SYSTEM INTEGRATION AND PROGRAMMING

- A. Programming and Integration for Control Systems:
 - 1. Full system programming shall be provided for the system. Programming shall be performed by a factory trained and certified programmer or an employee of the equipment manufacturer.
 - 2. The Contractor shall schedule a series of meetings with the Owner and Architect/Engineer to define and determine the exact integration requirements of the control system prior to the installation of the control system and components. An Owner sign-off of the final configuration shall be required.
 - 3. This section only defines the minimum requirements. The programmer shall provide complete programming for a fully functional system.
 - 4. The Contractor shall utilize the latest version of the programming software.
 - 5. The Contractor shall ensure that all components are updated to the latest firmware at the completion of the project.
 - 6. The IP-based control system and controlled components shall be on a dedicated Virtual LAN (VLAN) for the A/V systems. These components shall be on a dedicated subnetwork of the VLAN. The Contractor shall coordinate these requirements with the Owner prior to installation.

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7. Integration and programming of the following pieces of equipment shall be provided, with the following minimum features and functions:
 - a. All equipment shall include on/off control, except for equipment that must remain active for system functionality.
 - b. Integration of HDCP (High-bandwidth Digital Content Protection) and DPCP (Display Port Content Protection) protected content and sources:
 - 1) No protected sources or content shall be allowed to be selected to route through non-protected devices and displays. A warning shall be displayed stating this information to the user.
 - c. Audio Conference Integration:
 - 1) Refer to DSP Audio Processor Integration for requirements.
 - d. Display Integration:
 - 1) The displays shall be integrated into the A/V control system via bi-directional RS-232 or Ethernet control. Provide with the following minimum functions:
 - (a) On/off control.
 - (b) Display status feedback.
 - (c) Source switching control.
 - (d) Audio volume control with mute.
 - (e) Video mute.
 - e. Pan/Tilt/Zoom (PTZ) Camera Integration:
 - (a) The Contractor shall provide Ethernet control system connections and programming with the following minimum functions:
 - (b) Provide full pan, tilt and zoom control from Owner's production suite.
 - (c) Provide presets for fixed camera positions, contractor shall coordinate with the Owner for desired preset positions.
 - B. Programming and Configuration for Touch Panels:
 1. This section only defines the minimum requirements. The programmer shall provide complete touch panel layouts and programming for a fully functional system.
 2. The Contractor shall schedule a series of meetings with the Owner and Architect/Engineer to define and determine the exact touch panel layout requirements prior to the purchase and installation of the touch panels. An Owner sign-off of the final layouts shall be required.
 - a. Vendor shall work with City of Madison IT Media Team to ensure that user interfaces on touch panels are similar in function and appearance to those of other City of Madison facilities.
 3. Contractor logos are not allowed on the touch panels. The Contractor shall coordinate with the Owner on desired logos to be displayed.
 4. All programming for interface and control of all devices shown on the drawings shall be provided. Programming shall be provided for the following minimum functionality:
 - a. The main screen shall include graphical buttons for the primary room functions.
 - 1) Upon selection of the graphical button, all the required functions shall be displayed on the screen. All required equipment shall turn on.
 - b. Master System On/Off Control:
 - 1) When the master system off button is selected, all capable components within the system shall be turned off or placed on standby, except for equipment that is required to remain on for the system to function like the control system processor.
 - c. The main screen shall include graphical buttons for the selection of individual source selections.
 - 1) Upon selection of the graphical button for a source selection, all functional controls for the pieces of equipment, as well as all status indicators, shall be provided in graphical format on the screen.
 - 2) Rooms with multiple independent outputs and displays shall have a source routing matrix to allow any input to be routed to any output.
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- d. At all times, on all screens, a button shall be provided to return to the main screen, except for modal pop-ups.
 - e. A master volume control and mute shall be provided at all times on all screens, except for modal pop-ups.
 - f. A master video mute shall be provided at all times on all screens, except for modal pop-ups and audio-only functions.
 - g. A modal countdown timer shall be displayed showing the warmup and cooldown time of the projector. All functions shall be locked out while the projector is in cooldown mode.
 - h. All unused hard buttons shall not be labeled. A blank touch panel bezel shall be provided if no hard buttons are used.
- C. Touch Panel Layout Principles, Considerations and Guidelines:
- 1. Icons and Buttons:
 - a. Icons shall not be used solely as a button but can be embedded in a button.
 - b. Icons shall appear to be flat and un-pressable.
 - c. Status bars or text windows for time, date, room number, and similar information shall appear to be slightly depressed into the screen and appear to be un-pressable.
 - d. Buttons shall appear to be pressable by appearing to come off the screen with beveled edges, lighting gradients, and shadows. When pressed, the button shall appear to be depressed into the screen.
 - 1) Buttons that are momentary shall change color when pressed, appear to depress, then pop back up and revert to the original button color and state.
 - 2) Buttons that are not momentary shall change color when pressed, appear to depress, remain depressed, then pop back up, and revert to the original button color and state when pressed again.
 - e. Buttons and icons shall appear to be lit from the top left corner of the screen.
 - f. Buttons shall be grouped together according to general function.
 - g. Button size shall be based on the ratio of Phi (1:1.618) and be sized appropriately based on the screen area and dpi (pixel pitch).
 - h. Maintain a minimum of 5 to 10 pixels between buttons on small to medium touch panels, and a minimum of 10 to 15 pixels between buttons on medium to large touch panels.
 - i. Telephone dialer keypads shall be based on the ITU-T E.161/ANSI TI-703 standard telephone layout and include the a-z letters below each appropriate number.
 - j. TV and radio tuner keypads shall be based on the ITU-T E.161/ANSI TI-703 standard telephone layout, except for the asterisk (*) being replaced by a dot (.) and the pound (#) being replaced with Enter.
 - k. IP-address keypads shall be based on the standard computer keyboard 10-key numeric keypad typically found on the right side of the keyboard.
 - l. Buttons such as Power, Play, Stop, Record, Rewind, Previous, Forward, Eject, Return, Next, Up, Down, Left, Right, Plus, Minus, etc. shall use standard industry symbols. Record shall always be a solid red circle.
 - 2. Text and Fonts:
 - a. The Contractor shall use a standard sans-serif bold Arial or Calibri font style unless the Owner dictates otherwise.
 - b. Words shall have the first letter capitalized and the rest of the word lower case. No words shall be all capitals or all lower case. Follow standard grammatically correct sentence structure where the first word is capitalized and the rest of the sentence is lower case, followed by the appropriate punctuation mark with accurate syntax and correct verbs.
 - c. All font size in a single group or cluster shall maintain the same font size. Headers to a group or cluster shall have a slightly enlarged font size. and footers shall have a slightly smaller font size in comparison to the group font size to maintain a visual hierarchy.
 - 3. Color Considerations:
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- a. Colors shall be selected so that, when converted to monochrome, all text, buttons, icons, groups, clusters, borders, etc. are clearly visible to accommodate all color blind or color-impaired individuals and ADA requirements.
 - b. Background colors shall be cool low saturation colors such as grey, blue, or green and their analogous colors, and be a gradient from top down or top left to bottom right.
 - c. Base colors shall be analogous to the background color but be of a higher saturation to stand out more clearly.
 - d. Button colors shall be analogous to the background color, stand out clearly from the base colors, and be of a higher saturation cool color, gray, or a low saturation black.
 - e. Icon, symbols, and text color shall be a neutral white or black, or a low saturation grey, and shall clearly stand out from the background or button it is placed on.
 - f. Buttons for modal acknowledgement, exit or return, or other modal action shall be a warm color such as red or yellow and their analogous colors.
 - g. Buttons, icons, symbols or text for emergency or urgent notifications shall be bright red.
 4. Pages and Background:
 - a. Groups and clusters shall have clearly defined borders, with spacing between adjacent groups.
 - b. Modal pop-up windows or pages shall be required when a command requires user input before it is executed or when a button has multiple nested elements to control, such as microphone volumes, zone control, lighting and environment control, advanced system controls, etc.
 - 1) The modal pop-up pages shall dim and grey out the background and buttons, overlay the main page, and have a clear back or exit button to bring the user back into the active page the user was on before the modal pop-up.
 - 2) A model pop-up timer page shall appear when a projector is being turned on or off for the appropriate warmup or cooldown time. No additional commands shall be allowed during this time.
 - 3) Model pop-ups shall not replace or completely overlay the background.
 - c. Images or pictures shall never be used as backgrounds to any page other than a master start page, if appropriate.
 5. Touch Panel Layout Guideline Template:
 - a. IMAGEClient Logo - Static Window.
 - b. A/V Source Selection - Static Window.
 - c. Display Power, Screen Controls, Light Controls, Shade Controls, and other Environmental Controls Static Window.
 - d. Controls for Selected Source and Status or Home Page - Dynamic Window.
 - e. Master Volume and Mute, Video Mute, and Microphone Volume - Static Window.
 - f. Home Button - Static Window.
 - g. Date, Time, and Room Number - Static Window.
 - h. Master System Off - Static Window.

3.10 FIELD QUALITY CONTROL

- A. Where these specifications require a product or assembly without the use of a brand or trade name, provide a product that meets the requirements of the specifications, as supplied and warranted by the system vendor. If the product or assembly is not available from the system vendor, provide product or assembly as recommended by the system vendor.
- B. Periodic observations will be performed during construction to verify compliance with the requirements of the specifications. These services do not relieve the Contractor of responsibility for compliance with the Contract Documents.

3.11 FIELD SERVICE

- A. The installer shall conduct a planning meeting with the Owner. The purpose of this meeting shall be to determine all equipment settings that are considered preferences {where proper system operation does not depend on the setting}.
- B. The installer shall include labor for all planning and all programming activities required to implement the Owner's preferences for equipment settings.
- C. It shall be the responsibility of the Contractor/installer to provide a complete, functional system as described by the design documents. These responsibilities include:
 - 1. Complete hardware setup, installation and wiring and software configuration.
 - 2. Complete programming of software in accordance with the Owner's desires determined by the planning meeting.
 - 3. Complete system diagnostic verification.
 - 4. Complete system commissioning.

3.12 SYSTEM ACCEPTANCE

- A. The Contractor shall submit for review a formal acceptance and system checkout procedure. The system checkout procedures shall include all system components and software. The Contractor shall perform the tests and settings and document all results.

3.13 SYSTEM DOCUMENTATION

- A. Complete documentation shall be provided for the system. The documentation shall describe:
 - 1. All operational parameters of the system.
 - 2. Complete documentation of programming and features.
 - 3. Complete operating instructions for all hardware and software.
- B. The following sections shall be provided in the system documentation:
 - 1. User Manual: A step-by-step guide and instructions detailing all system user functions.
 - 2. Technical Manual: A comprehensive document providing all system operations, troubleshooting flowcharts, functional system layout, wiring diagrams, block diagrams and schematic diagrams.
 - 3. Maintenance Manual: A comprehensive document on all aspects of physical maintenance of the systems, including cleaning of the displays, bulb changes, filter cleaning, filter changing and UPS maintenance.

3.14 SYSTEM TRAINING

- A. All labor and materials required for on-site system training shall be provided. Training shall be conducted at the project site using the project equipment.
 - 1. Provide two week's advanced notice of training to the Owner and Architect/Engineer.
 - 2. The Architect/Engineer shall be presented with the option to attend the training.
 - 3. Provide a training outline agenda describing the subject matter and the recommended audience for each topic.
- B. At a minimum, the following training shall be conducted:
 - 1. User Manual: A course detailing the system functions and operations that a daily user will encounter.
 - 2. Technical User: Provide configuration training on all aspects of the system(s), including equipment and software.
 - 3. Maintenance User: Provide training on all aspects of physical maintenance of the systems, including cleaning of the displays, bulb changes, filter cleaning and filter changing.
- C. Minimum on-site training times shall be:
 - 1. User Manual: One (1) day.
 - 2. Technical user: One (1) day.
 - 3. Maintenance user: Four (4) hours.

4. The Contractor shall include in his/her bid one (1) additional day of training each quarter for the 12-month period of the project warranty. The Contractor shall return to the site for additional follow-up training during this period.

END OF SECTION

SECTION 27 41 16
PARK PAVILION AUDIO VISUAL SYSTEM

PART 1 - GENERAL

1.01 SCOPE

- A. This section includes furnishing and installing an AV system including speakers, controls and other equipment required for a complete operating system.
- B. Applicable provisions of Division 01 – General Requirements shall govern all work under this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Scope.
 - 2. Summary.
 - 3. Applicable Codes.
 - 4. System Functions.
 - 5. Quality Assurance.
 - 6. Submittals.
 - 7. Bill of Material.
 - 8. General Provisions.
 - 9. Wiring.
 - 10. Equipment Grounding.
 - 11. Equipment Racks.
 - 12. Work Included.
 - 13. Maintenance and Operation Manuals.
 - 14. Commissioning.
 - 15. Warranty.
- B. Related Sections:
 - 1. Section 26 05 26 – Grounding and Bonding.
 - 2. Section 26 05 29 – Electrical Hangers and Supports.
 - 3. Section 26 05 33.13 – Conduit for Electrical Systems.
 - 4. Section 26 05 33.16 - Boxes for Electrical Systems.
 - 5. Section 26 05 33.23 - Surface Raceways for Electrical Systems.
 - 6. Section 27 00 05 - Communications Cabling
 - 7. Section 27 41 00 - Professional Audiovisual Systems
- C. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association, the Wisconsin Electrical Code and present manufacturing standards.
- D. All materials shall be listed by UL and shall bear the UL label. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.
- E. Other applicable standards (plus applicable update bulletins and errata) are as follows:
 - 1. General.
 - 2. ANSI/IEEE C2 - National Electrical Safety Code.
 - 3. SPS Chapter 316 – Wisconsin Dept. of Safety and Professional Services Electrical Code.
 - 4. IEEE/ANSI 142-1982 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.

1.03 SYSTEM FUNCTIONS

- A. The audiovisual system shall accept input from these sources:
 - 1. Wireless microphones.
 - 2. The local area network.
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3. Portable devices connected via wall plate.
 4. Portable devices connected via Barco click-share system.
 5. The cable TV network.
- B. It will provide amplified sound over ceiling speakers and video displays and video projectors via devices connected via wall plates or the Barco click-share system. All functions will be controlled via touch-screen wall plates located at the front of the Event Spaces. Equipment will be installed in wall rack in an adjacent Storage Room.
- C. System shall sense position of folding partition and automatically combine or separate Event Space AV functions and inputs. Provide an output contact for the building automation system to inform it of the partition position. In addition, Crestron system shall be able to effect combination manually in the event of a sensor failure.
- D. When a patron plugs into an HDMI jack at a wall plate or a floor box, the projector will automatically turn on and show video, and the audio amplifier will turn on and broadcast audio without help from staff.
- E. When a patron plugs an audio source into a 3.5 mm jack at a wall plate, the audio amplifier will automatically turn on and broadcast audio without help from staff.
- F. These functions shall be available from the Crestron touch-screens:
1. Raise/lower Lutron shades.
 2. Raise/lower projection screens.
 3. Power-on projector.
 4. Select sound source.
 5. Select volume level.
 6. Combine or separate room halves.

1.04 QUALITY ASSURANCE

- A. See Section 27 41 00.

1.05 SUBMITTALS

- A. See Section 27 41 00.
- B. Bidder Qualifications
1. See Section 27 41 00.

PART 2 - PRODUCTS

2.01 BILL OF MATERIAL

- A. See plans including sheets T701 through T704 for materials.

PART 3 – EXECUTION

3.01 GENERAL PROVISIONS

- A. Contractor shall furnish all required equipment whether or not specifically mentioned in these specifications or on the drawings. Such devices shall include but not be limited to hardware, fasteners, rack screws, rack brackets, power supplies, grille covers, impedance matching devices, transformers, line pads, line amplifiers, relay and LED power supplies, and other devices as necessary to interface, control, or balance the AV systems.
- B. All devices shall be capable of being shut down except the control system itself.

3.02 WIRING

- A. All wiring shall be run in conduit.
- B. Manufacturers minimum bend radius specifications shall be observed in all instances.

3.03 EQUIPMENT GROUNDING

- A. See Section 26 05 26.

3.04 EQUIPMENT RACKS

- A. All interface plates and panels must be permanently labeled or engraved. Rack blanks and vented panels shall be used in rack spaces that do not have equipment occupying them.

3.05 WORK INCLUDED

- A. The following shall be the responsibility of the Contractor:
1. Furnish and install all equipment, panels, and devices associated with the AV systems.
 2. Termination of all AV systems wiring.
 3. AC 120-volt power and wiring within AV systems equipment racks.
 4. Preparation of AV design, shop drawings, maintenance manuals, wiring diagrams and other submittals required by the individual AV system specification sections.
 5. Tests, balancing, trouble shooting, adjustments and other similar work as may be required to insure complete operating AV systems.
 6. AV training.
 7. Warranty work associated with the building audio-visual systems.

3.06 MAINTENANCE AND OPERATION MANUALS

- A. See Section 27 41 00.

3.07 COMMISSIONING

- A. See Section 27 41 00.

3.08 WARRANTY

- A. See Section 27 41 00.

END OF SECTION

SECTION 27 51 16
LIBRARY AUDIO VISUAL SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Applicable provisions of Division 01 – General Requirements shall govern all work under this Section.
- B. This section includes furnishing and installing AV systems including speakers, controls and other equipment required for complete operating systems.
 - 1. Local programming and Zoom-room system for the Community Room 107.
 - 2. Local programming and Zoom-room system for Classroom 109.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 33.16 - Boxes for Electrical Systems.

1.03 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SYSTEM DESCRIPTION

- A. Community Room 107
 - 1. Provide voice lift for local meetings.
 - 2. Play program material from patrons' devices on overhead speakers and flat screen displays.
 - 3. Participate via Zoom in remote meetings using audio from overhead ceiling microphone arrays and a local camera.
 - 4. Allow setup by patrons via wireless room controller.
 - 5. Facilitate future upgrade to Type 1 meetings and civic engagement.
 - 6. These functions shall be available from the Crestron touch-screens:
 - a. Raise/lower Lutron shades
 - b. Power-on flat screens
 - c. Initiate Zoom meeting
 - d. Select sound sources
 - e. Select volume level
- B. Classroom 109
 - 1. Provide voice lift for local meetings.
 - 2. Play program material from patrons' devices on overhead speakers and flat screen display.
 - 3. Participate via Zoom in remote meetings using audio from overhead ceiling microphone arrays and local cameras.
 - 4. Allow setup by patrons via wireless room controller.
 - 5. These functions shall be available from the Crestron touch-screen:
 - a. Power-on flat screen
 - b. Select sound source
 - c. Select volume level
 - d. Initiate Zoom meeting
- C. Input components:
 - 1. Community Room 107
 - a. Body pack microphones.
 - b. Handheld microphones.
 - c. Overhead ceiling microphone arrays and a local camera when in Zoom mode.
 - d. Patrons' devices via HDMI connection.
 - 2. Classroom 109

- a. Handheld microphones.
- b. Overhead ceiling microphone array and local cameras when in Zoom mode.
- c. Patrons' devices via HDMI connection.

1.05 SUBMITTALS

- A. See Section 27 41 00.

1.06 QUALITY ASSURANCE

- A. See Section 27 41 00.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.07 BIDDER QUALIFICATIONS

- A. See Section 27 41 00.

PART 2 PRODUCTS**2.01 BILL OF MATERIAL - COMMUNITY ROOM 107**

- A. See plans including sheets T701 through T704 for materials.

2.02 BILL OF MATERIAL - CLASSROOM 109

- A. See plans including sheets T701 through T704 for materials.

2.03 AMPLIFICATION AND CONTROL EQUIPMENT

- A. Dante enabled.
- B. Microphone Inputs: Two low impedance inputs with 600 microvolt sensitivity and noise level at least 55 dB below rated output.
- C. System Frequency Response: 50 to 15,000 Hz, plus or minus 2 dB.
- D. System Distortion: Less than 1.5 percent, 100 to 100,000 Hz at rated power.
- E. System Output: 4 ohms 25 volts.
- F. Volume Controls: One for each input and one master volume.
- G. Bass Control: Plus 8 dB to minus 12 dB at 50 Hz.
- H. Treble Control: Plus 8 dB to minus 12 dB at 10,000 Hz.
- I. Program Selector: Provide program , listen-talk, and mode selector switches.
- J. System Cabinet: Console mounted.

2.04 COMPONENTS

- A. Speakers: 8 inch coaxial speaker with integral crossover circuit.
 - 1. Power Rating: 20 watts.
 - 2. Frequency Range: 45 to 18,000 Hz.
 - 3. Sound Pressure Level: 95 dB at 3 feet with 1 watt input.
 - 4. Magnet: Ceramic; 10 ounces low frequency unit; 3 ounces high frequency unit.
 - 5. Dispersion: Minus 3 dB at 90 degrees, minus 5 dB at 110 degrees.
- B. Speaker Baffles and Enclosure: Round, painted steel, with uniform perforations.
 - 1. Size: 12 inch.
 - 2. Finish: White.
 - 3. Speaker Backbox: Insulated with sound-deadening material.
- C. Matching Transformers: Tapped from 0.5 to 4 watts in 1 watt steps, with primary/secondary ratio to match amplifier to speaker impedances.
- D. Volume Pads: Transformer type rated 10 watts.

2.05 WIRE AND CABLE

- A. Microphone Cord: 20 AWG stranded copper conductor, 600 volt insulation, rated 60 degrees C, two conductor shielded cable with rubber jacket.
- B. Speaker Wire and Cable: 22 AWG copper conductor, 300 volt insulation, rated 60 degrees C, paired conductors twisted together shielded and covered with a PVC jacket.

PART 3 EXECUTION**3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Mounting Heights: Coordinate locations of outlet boxes specified in Section 26 05 33.16 to obtain mounting heights indicated.
- C. Splice cable only in accessible junction boxes or at terminal block units.
- D. Make cable shields continuous at splices and connect speaker circuit shield to equipment ground only at amplifier.
- E. Install input circuits in separate cables and raceways from output circuits.
- F. Provide protection for exposed cables where subject to damage.
- G. Use armored cable for outside speaker circuits.
- H. Support cables above accessible ceilings to keep them from resting on ceiling tiles. Use spring metal clips or plastic cable ties to support cables from structure for ceiling suspension system. Include bridle rings or drive rings.
- I. Use suitable cable fittings and connectors.
- J. Connect reproducers to amplifier with matching transformers.
- K. Ground and bond equipment and circuits in accordance with Section 26 05 26.

3.02 FIELD QUALITY CONTROL

- A. See Section 27 41 00.

3.03 ADJUSTING

- A. Adjust transformer taps for appropriate sound level.
- B. Adjust devices and wall plates to be flush and level.

3.04 CLOSEOUT ACTIVITIES

- A. See Section 27 41 00.

END OF SECTION

**SECTION 27 51 23
FLAT SCREENS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Flat screen displays in various locations to display owner generated content via the local area network.
- B. NUC's to provide HDMI outputs for the displays.
- C. Cabling.
- D. Licenses.
- E. Install a City-furnished Brightsign player and connect to displays.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
- C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- D. Section 26 05 33.13 - Conduit for Electrical Systems,
- E. Section 26 05 53 - Identification of Electrical Systems.
- F. Section 27 00 05 - Communications Cabling
- G. Section 27 41 00 - Professional Audio/Video Systems

1.03 SUBMITTALS

- A. Shop Drawings: Indicate cable routing and connections.
- B. Product Data: For each item of equipment.

1.04 QUALITY ASSURANCE

- A. Products: Listed, classified, and labeled as suitable for the purpose intended.
- B. 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**2.01 DISPLAYS**

- A. Manufacturers:
 - 1. Samsung 65" PM-H (basis of design).
 - 2. Sharp.
 - 3. Sony
 - 4. Christie
 - 5. NEC.
 - 6. Philips.
 - 7. Panasonic.
 - 8. Substitutions: See Section 01 60 00 - Product Requirements.
 - B. Specifications:
 - 1. Diagonal size: 65".
 - 2. Operations hours: 24/7.
 - 3. Resolution: 1920 x 1080 (full HD)..
 - 4. Type: 60 Hz E-LED BLU.
 - 5. Brightness: 500 nit.
 - 6. Viewing angle: 178:178.
 - 7. Contrast ratio: 4000:1.
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8. Pixel pitch: 0.21 mm x 0.63 mm.
9. Display colors: (10 bit dithering) - 1.07 Billion.
10. Built-in speaker.
11. Inputs: RGB, HDMI 2.0 (2), HDCP, USB 2.0 (2).

C. Provide similar for 55" displays.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work.
- B. Verify field measurements are as indicated on drawings.
- C. Verify that required utilities are available, in proper location, and ready for use.
- D. Beginning of installation means installer accepts conditions.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Wiring Method:
 1. Use listed plenum rated cables in spaces used for environmental air.
 2. Install wiring in conduit where required for rough-in, where required by authorities having jurisdiction, and where exposed to damage.
 3. Conduit: Comply with Section 26 05 33.13.
 4. Conceal all cables unless specifically indicated to be exposed.
 5. Cables in the following areas may be exposed, unless otherwise indicated:
 - a. Equipment closets.
 - b. Within joists in areas with no ceiling.
 6. Route exposed cables parallel or perpendicular to building structural members and surfaces.
- C. Provide grounding and bonding in accordance with Section 26 05 26.
- D. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- E. Identify system wiring and components in accordance with Section 26 05 53.
- F. Provide all licenses necessary for displays.
- G. Provide all components necessary to interface displays with Owner's program source.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 45 16 - Field Quality Control Procedures for City of Madison additional requirements.
- B. Perform operational test on completed installation to verify proper operation.
- C. Replace equipment, components, and wiring to eliminate audible noise, clicks, pops, or hum when system is in standby or operation.

3.04 ADJUSTING

- A. Adjust controls and configuration switches for operation as indicated.

3.05 DEMONSTRATION

- A. Provide systems demonstration and instructions. Allow minimum of one (1) hours.

END OF SECTION

SECTION 28 13 00
ACCESS CONTROL SYSTEM (KEYSCAN)

PART 1 GENERAL

1.01 SUMMARY

- A. The City of Madison Information Technology Department has been assisting other City agencies with standardizing facilities through the use of access cards, key fobs, and punch pads. All hardware is installed locally at the facility while software controls access to various doors remotely.
- B. These specifications describe the materials, equipment, and installation requirements to install an integrated, computerized access control and alarm monitoring system utilized by the City of Madison Information Technology (CoM-IT) Department.
- C. The ACS System Contractor shall be responsible for verifying equipment requirements, locations, and coordination with the General Contractor and all other necessary trades as needed for a complete installation.
- D. The ACS System Contractor shall be aware that the installation plans and specifications are for one (1) building with (3) separate areas and shall be wired as such. Refer to the Part 3-Execution for additional details.

1.02 RELATED SPECIFICATIONS

- A. 01 31 23 - Project Management Web Site.
- B. 01 33 23 - Submittals.
- C. 08 71 00 - Door Hardware.
- D. 27 00 05 - Communications Cabling.

1.03 RELATED DRAWINGS

- A. Refer to all Electrical drawings for locations of distribution panels and equipment as it relates to standard line voltage locations.
- B. Refer to all Technical drawings for locations of Access Control System (Keyscan) equipment.
- C. Refer to the door hardware schedule and Architectural floor plans for information relating to door access locations and specific hardware requirements.

1.04 REFERENCES

- A. The system shall comply with the standards, codes and regulations of the following regulatory bodies:
 - 1. Underwriters Laboratories (UL) Std No. 294 – Access Control System Units.
 - 2. Canadian Standards Association (CSA) Std C22.2 No. 205-M1983 – Signal Equipment.
 - 3. CE Standards.
 - a. EN 55022 RF Emissions.
 - b. EN 55024 RF Immunity.
 - c. EN 60950-1 Equipment Safety.
 - 4. FCC Subpart B – RF Emissions.
 - 5. Industry Canada ICES 003 Emissions.
 - 6. RoHS.

1.05 CONTRACTORS QUALIFICATIONS

- A. The Contractor installing the ACS system shall:
 - 1. Be a Certified Keyscan Enterprise Partner.
 - 2. Utilize installers who are Keyscan Enterprise Certified Technicians.
 - 3. Be able to provide 24/7/365 support during the warranty period of this project.
 - 4. Be able to respond and repair or replace most components within 4 hours of notification.

1.06 SUBMITTALS

- A. The Contractor shall provide a complete submittal package in a timely manner to allow sufficient review time prior to ordering the system components required for a complete installation. The contractor shall be solely responsible for any equipment, purchased/ordered/delivered that is not approved of during the submittal review process.
- B. The complete submittal package shall include but not be limited to the following:
 - 1. All certifications of the contractor and contractor's installation team. Certifications shall be current from the start of the contract through the end of the warranty period.
 - 2. Cut sheets indicating, shop drawings, performance data, and other such information that will indicate the component being installed matches the component that was specified.
 - 3. Cut sheets and shop drawing of Contractors recommendations for tags and labels.

1.07 WARRANTY

- A. The Contractor shall warrant for one year the complete installation of equipment and components associated with this contract and installation. Contractor's warranty shall be in the form of a written letter on company letterhead referring to the contract information, dates of installation and acceptance, signed by an authorized representative of the Contractors Company.
 - 1. The Contractor's warranty shall include but not be limited to the following:
 - a. Transportation to and from the location as often as needed during the warranty period.
 - b. All labor and materials necessary to properly and thoroughly trouble shoot the system.
 - c. All fees associated with the shipping of any component that needs to be returned or supplied by the manufacturer for repair or replacement.
 - d. All labor and materials required to remove, repair, replace, or re-install any component.
- B. The Contractor shall also provide all manufacturers warranties/guarantees associated with installed components of the completed installation.

1.08 QUALITY ASURANCE

- A. The Contractor shall be responsible for coordinating his/her Work with other trades and divisions as needed for a complete installation. This shall include pre-installation meetings for locating equipment, conduit, cabling, control devices, and other materials and equipment required by this installation.
- B. The General Contractor (GC) shall be responsible for ensuring that all doors requiring controlled access are properly prepared and installed per the contract documents. The GC shall further be responsible for ensuring all project coordination, pre-installation meetings, submittals and other such project management responsibilities are conducted efficiently and according to the project specifications and schedules.

PART 2 PRODUCTS**2.01 EXISTING SYSTEM PRODUCTS OVERVIEW**

- A. The City of Madison Information Technology Department (CoM IT) owns and operates a fully licensed copy of the Keyscan Access Control System software.
 - 1. The Keyscan Access Control System (ACS) provides controlled access to secured doors and elevators through the use of electronic door latches, proximity readers, control panels, and a proprietary software program.
 - 2. The Keyscan software allows CoM-IT and the facility the Owner to customize multiple levels of access and system performance through any combination of the following:
 - a. Calendar and time based lock/unlock controls
 - b. Group access control for common personnel groups
 - c. Individual access control for specialized access control
 - d. Elevator access control for accessing/not accessing various floors
 - e. Temporarily disable access control for a specified time period
 - f. Remotely unlock/lock a door
 - g. Lockdown a facility from one location

- h. Provide customizable alert notifications

2.02 NEW EQUIPMENT AND COMPONENTS

- A. The Contractor guarantees that all equipment and components shall be furnished new, undamaged, free of defects, and conform to the drawings and specifications of this contract. The contractor is solely responsible for replacing any damaged or defective item.
- B. New ACS components on interior and exterior access doors shall be able to be integrated with the Owners existing system.

2.03 DISTRIBUTION SUPPLY PANEL (AC-DS-1)

- A. AC-DS-1 brings line voltage into the ACS system with the following performance specifications:
 - 1. Input
 - a. 115VAC, 60Hz, 1.45A
 - 2. Output
 - a. Eight (8) PTC protected outputs
 - b. 16VAC output
 - c. 16VAC @ 10amp (175 VA) supply current (1.25 amp per device, 2.5 amp max.)
 - d. Outputs rated @ 2.5 amp
 - e. Main fuse rated @ 15 amp/32V
 - f. Surge suppression
 - 3. Miscellaneous electrical information
 - a. Operating temperature 0° C to 49°C ambient
 - b. 82 BTU/hr
 - c. System AC input VA requirement 166.75 AV
 - 4. Miscellaneous required features
 - a. AC power LED indicators
 - b. Illuminated master power disconnect circuit breaker with manual reset
 - 5. Agency Approvals
 - a. UL 294 listed for Access Control System Units
 - b. CUL listed-CSA Standard C22.2 No 205-M1983 Signal Equipment
- B. AC-DS-1 shall be:
 - 1. Altronix, AL168175CB
 - 2. Pre-approved equal

2.04 POWER SUPPLY PANEL (AC-PS-1)

- A. The AC-PS-1 brings line voltage from the AC-DS-1, reduces then distributes the voltage to the Access Security Panels (AC-SEC-1) with the following performance specifications:
 - 1. Input
 - a. 115VAC, 60Hz, 1.9A
 - b. Power supply input options
 - 1) One (1) common power input for ACM8 and lock power (factory installed)
 - 2) Two (2) isolated power inputs; one (1) to power the ACM8 and one (1) for lock accessory power, (external power supply is required). Current is determined by the power supply connected, not to exceed a maximum of 10 amp total
 - c. Eight (8) Access control System trigger inputs with the following options:
 - 1) Eight (8) normally open (NO) inputs
 - 2) Eight (8) open collector inputs
 - 3) Any combination of the above
 - 2. Output
 - a. 12VDC or 24VDC @ 6 amp supply current
 - b. Eight (8) independently controlled outputs with the following options:
 - 1) Eight (8) Fail-Safe and/or Fail-Secure power outputs

-
- 2) Eight (8) form "C" 5 amp rated relay outputs
 - 3) Any combination of the above
 - c. Eight (8) auxiliary power outputs (un-switched)
 - d. Output fuses rated @ 3.5 amp
 - e. Filtered and electronically regulated outputs (built-in power supply).
 - 3. Miscellaneous electrical information
 - a. Operating temperature 0° C to 49°C ambient
 - b. BTU/hr:
 - 1) 12VDC = 36.85 BTU/hr
 - 2) 24VDC = 73.70 BTU/hr
 - c. ACM8 board main fuse is rated at 10 amp
 - 4. Battery Backup
 - a. Built-in charger for sealed lead acid or gel type batteries
 - b. Power supply board maximum charge current 0.7 amp
 - c. Automatic switch over to stand-by battery when AC fails
 - d. Zero voltage drop when unit switches over to battery backup (AC failure condition)
 - e. Battery fail and battery presence supervision (form "C" contact)
 - 5. Miscellaneous required features
 - a. Fire Alarm disconnect (latching or non-latching) is individually selectable for any or all of the eight (8) outputs.
 - b. Fire Alarm disconnect input options:
 - 1) Normally open (NO) or normally closed (NC) dry contact input
 - 2) Polarity reversal input for FACP signaling circuit
 - c. Alarm output relay indicates that FACP input is triggered (form "C" contact rated @ 1 amp 28VDC)
 - d. Short circuit and thermal overload protection
 - e. AC fail supervision (form "C" contact)
 - f. Red LEDs indicate outputs are triggered (relays energized)
 - g. Green LED indicates FACP disconnect is triggered
 - h. AC input and DC output LED indicators
 - i. Enclosure accommodates up to two (2) 12AH batteries
 - 6. Agency Approvals
 - a. UL 294 listed for Access Control System Units
 - b. CUL listed-CSA Standard C22.2 No 205-M1983 Signal Equipment
- B. AC-PS-1 shall be:
- 1. Altronix, AL600ULACM
 - 2. Pre-approved equal

2.05 SECURITY PANEL (AC-SEC-1)

- A. The AC-SEC-1 distributes the reduced voltage and control wiring to/from each door with an access control device.
- B. AC-SEC-1 shall be:
 - 1. Keyscan CA8500 – 8 Reader Access Control Panel
- C. The AC-SEC-1 shall be provided, located and mounted by the Contractor.
- D. Provide quantity required.
- E. Provide separate security panels for doors/items controlled by City-IT and doors controlled by City-Library.

2.06 DOOR CONTROL DEVICES

- A. The Contractor shall be responsible for verifying the Door Control Device (DCD) quantities and locations with the door hardware schedule.
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B. DCD shall be:

1. Keyscan K-KPR – Keyscan Proximity Reader/Keypad, this reader accepts swipe monitoring of cards, key fobs, and other such devices as well as accepting personal identification numbers (PINs)
 - 1) Plan designation = AC-CR-A for door control device associated with City-Library system.
 - 2) Plan designation = AC-CR-B for door control device associated with City-IT system.
2. The K-KPR shall be used for all locations.

2.07 DOOR CONTROL CABLES

- A. The following cables are required for a complete installation of the ACS, per controlled door, as follows:
 1. One (1) 22/6 shielded cable, required; to DCD
 2. One (1) 18/2 un-shielded cable, required; lock power
 3. One (1) 22/2 un-shielded cable, required; door contact
 4. One (1) 22/4 un-shielded cable, required but not used; for future request to exit sensors
- B. At the Contractors option he/she may run a manufactured cable bundle containing all four (4) cables listed above. It shall be the sole responsibility of the contractor to appropriately size the conduits for the installation.

PART 3 EXECUTION**3.01 COOPERATION OF THE ACS CONTRACTOR**

- A. The Contractor shall be required to coordinate with all trades for a complete and timely installation. This includes attending all pre-installation meetings where equipment locations, conduit locations, and control devices will be installed or may be in conflict with the installation of other trades. The Contractor shall be solely responsible for any additional cost required for removing/replacing/modifying any completed work by other trades because the installation was not properly coordinated.
- B. The Contractor shall coordinate with the Owners Representative from City IT for all information necessary to complete the installation and integration with the Owners existing hardware and software.
- C. The Contractor shall verify with the appropriate Owners Representative for mounting heights of all hardware and equipment prior to installation. This shall be completed at a pre-installation walk through prior to rough-in.
- D. The Contractor shall coordinate with the elevator equipment installer the location and wiring of the EFACP.
- E. The Contractor shall coordinate with the Owner's Representative from City IT to verify all requirements for all access controlled doors are properly coordinated and understood prior to roughing in the installation.

3.02 GENERAL EQUIPMENT MOUNTING

- A. All ACS equipment shall be mounted to the 3/4" AC fire rated plywood panels provided and installed by the General Contractor. Contractor shall tape out all equipment prior to mounting to insure adequate space is allotted for the complete installation per the riser diagrams including all related conduits and cables.
- B. All equipment shall be neatly arranged so as to meet or exceed the manufacturer's recommended working space around each component.
- C. Equipment to be installed on plywood mounting panels shall include but not be limited to the following:
 1. Distribution Service Panel (AC-DS-1)
 2. Power Supply Panel (AC-PS-1)
 3. Access Control Panel (AC-SEC-1)

4. All required conduits, and boxes for line voltage

3.03 GENERAL CONDUITS AND WIRING

- A. This section shall apply to both the ACS Contractor and the Electrical Contractor. The following division of responsibilities shall apply:
 1. The Electrical Contractor shall be responsible for furnishing, installing, and connecting all conduits, connectors, conductors, and other related materials associated with providing line voltage to the ACS system as follows:
 - a. Providing an 110V, 20A, dedicated circuit from the designated distribution panel to AC-DS-1 as described in Section 2.3 above.
 - b. Providing line voltage from AC-DS-1 to AC-PS-1 as described in Section 2.4 above.
 2. The ACS Contractor shall be responsible for furnishing installing, and connecting all conduits, connectors, conductors and other related materials required to complete the installation of the low voltage wiring and door controller cabling.
- B. All conduits shall be properly sized for the number of wires or wire bundles being pulled through the conduit. The Contractor shall verify with the manufacturer the recommended fill rate by conduit size and shall not exceed the recommendations.
- C. The contractor shall neatly lay out all conduits in such a fashion so as to minimize bending, crossovers, etc.
- D. Bends, pull boxes, and pull points shall be sized and located as per all applicable codes and standards for the number of wires or wire bundles in the bend, pull box, pull point.
- E. CAT6 cables from each AC-SEC-1 shall be neatly run in cable management equipment supplied and installed by the cabling contractor or conduits supplied and installed by the ACS Contractor as needed. The switch to be used for all ACS equipment shall be located in Telecom Room 125. Cables shall be labeled on both ends per the cabling specification.
- F. The General Contractor and the ACS Contractor shall ensure the following Emergency Access requirements are properly installed and operational prior to the final Madison Fire Department inspection for occupancy.
 1. CoM IT shall provide a minimum of six (6) swipe cards to each installed Knox Box for emergency entrance. The cards shall be appropriately coded for entry at all controlled access doors.
 2. The following doors shall be wired to unlock in the event of an emergency.
 - a. As directed by Owner.

3.04 EQUIPMENT IDENTIFICATION AND LABELING

- A. The Contractor shall provide and install all equipment identification and labeling to the following specifications.
 1. Tags and labels shall be permanent rigid plastic or metal tags with engraved or machine stamped lettering. Hand written self stick or metal hand stamped tags will not be accepted.
 2. The Contractor shall work out the labeling scheme for doors with City IT, Owner, and Architect prior to ordering any labels or tags.
 3. The Contractor shall provide all labels and tags associated with this specification. This shall include the line voltage feed to each AC-DS-1 from the electrical distribution panel.
- B. Panels and Boxes
 1. All panels and boxes shall be labeled on the outside cover that readily identifies the panel/box as a "Distribution Supply", "Power Supply", "Access Control Panel", "Elevator Floor Access Control Panel", etc. An associated number shall also be on each tag and the number "1" shall be used even if there is only one of that type panel/box.
 2. Access Control Panels shall have a card index inside the front cover of each door indicating the controller number, door number, and door location being served by that panel.
- C. Conduits

1. Line voltage from electrical distribution panels shall have conduits labeled on both ends as follows:
 - a. At the distribution panel the line voltage conduit shall be labeled with the system supplied, and the ACS distribution supply panel number.
 - b. In the Telecommunications Room the line voltage conduit label shall indicate the distribution panel and circuit number(s) controlling the supply line.
2. Conduits between Access Control Panels and the controlled doors shall be labeled on both ends as follows:
 - a. In the Telecommunications Room each conduit shall be labeled with the door number(s) being supplied.
 - b. Above the finished ceiling where the conduit is exposed prior to going into the wall space that serves the door the conduit shall be labeled with the Door Control Panel and Controller number associated with the door being served.
 - c. If the conduit size is reduced as control cabling is supplied to doors along the run each change in conduit size shall be re-labeled as noted in 2.b. above.
3. Conduits between equipment and components in the Telecommunications Room do not need to be identified.

3.05 INSTALLATION TESTING AND ACCEPTANCE

- A. The CoM IT and the Owner shall be responsible for completing all software programming associated with the installation of this contract prior to the completion of the installation of the system components. It is the sole responsibility of the Contractor to notify the Owner no less than two (2) weeks in advance of completing the installation that all codes and time setting shall be prepared for final installation and testing.
- B. The Contractor, CoM IT, and the Owner shall test each access control point with swipe cards and PINs to insure the door unlocks.
- C. CoM IT shall test each door using the existing fully integrated software. This shall include but not be limited to the following:
 1. Remotely lock/unlock the doors
 2. Verify time clock feature works for locking doors
 3. Verify swipe cards and PINs work on all doors
 4. Verify emergency entrance cards for Knox boxes work on all doors for the areas served.
- D. The Contractor, CoM IT, and the Owner shall test the elevator floor access functions as follows:
 1. With swipe cards and PINs to ensure controlled access to all floors.
 2. With no swipe cards or PINs to ensure that the general public can only access the designated public floors and not controlled access floors.
 3. Verify time clock feature works for accessing floors
- E. A completed and accepted installation shall pass all of the above tests for all controlled access points.
- F. The warranty period for the completed and accepted installation shall not begin until the date of the accepted general contract. The Contractor shall coordinate this date with the General Contractor.

END OF SECTION

**SECTION 28 20 00
ELECTRONIC SURVEILLANCE**

PART 1 GENERAL

1.01 SUMMARY

- A. The City of Madison requires video surveillance of interior and exterior areas of the Imagination Center at Reindahl Park as indicated in the Technology plan sheets.
- B. This specification shall identify major equipment components and accessories required for a complete video surveillance installation. It does not include materials such as cables, boxes, connectors, conduit, supports and other ancillary equipment required to complete the installation.
- C. For the purposes of this specification the term Contractor shall refer to the person(s) responsible for installing the Electronic Surveillance System and may or may not be the same contractor installing other Division 27 and 28 related equipment. Other contractors having related work shall be referred to by full title (Electrical Contractor).

1.02 RELATED SPECIFICATIONS

- A. 01 31 23 - Project Management Web Site.
- B. 01 33 23 - Submittals.
- C. 01 78 23 - Operation and Maintenance Data.
- D. 01 78 36 - Warranties.
- E. 01 78 39 - As-Built drawings.
- F. All Division 27 specifications that may apply to this installation.

1.03 AREAS OF RESPONSIBILITY

- A. The General Contractor (GC) shall be responsible for ensuring all of the following:
 - 1. Coordinate all Contractor related work with the construction schedule.
 - 2. Coordinate all required Work with the Contractor and other trades during pre-installation meetings and resolve installation issues as needed.
- B. The Contractor shall be responsible for all of the following:
 - 1. For all equipment ordering and purchasing, setup, configuration, and testing of equipment being installed under this specification and connected to City of Madison-Information Technology (CoM-IT) servers and equipment.
 - a. Include any mounting brackets required for mounting camera equipment to the structure.
 - b. The Contractor shall be responsible for the bridge supports identified in Section 2.02.C below.
 - 2. Verification of Owner installation requirements prior to installing equipment and accessories.
 - 3. Provide all ancillary materials and equipment required to complete the installation.
- C. CoM-IT shall be responsible for all of the following:
 - 1. The CoM-IT shall be responsible for the Genetec system licenses.
 - 2. Provide connection to servers and other hardware necessary to bring installed equipment on line.
 - 3. Assist in final testing of equipment and equipment functions installed under this specification.

1.04 SUBMITTALS

- A. The Contractor shall provide submittals of the following:
 - 1. All applicable certifications and licenses of the Contractor and the Contractor's installation team. Applicable certifications and licenses shall be current from the start of the contract through the end of the warranty period.
 - 2. One (1) submittal for all ancillary A/V and A/V Contractor provided equipment required for a complete A/V installation as follows:

- a. Product information sheets and shop drawings indicating each type/size/model of A/V accessory required for a complete A/V installation. Information sheets shall include the following information:
 - 1) Performance data for the item
 - 2) Plan identification number(s) where applicable
 - 3) Quantity required for each model

1.05 WARRANTY

- A. The Contractor shall warrant for one year the complete installation of equipment and components associated with this contract and installation. Contractor's warranty shall be in the form of a written letter on company letterhead referring to the contract information, dates of installation and acceptance, signed by an authorized representative of the Contractor's Company.
 - 1. The Contractor's warranty shall include but not be limited to the following:
 - a. Transportation to and from the location as often as needed during the warranty period.
 - b. All labor and materials necessary to properly and thoroughly trouble shoot the system.
 - c. All fees associated with the shipping of any component that needs to be returned or supplied by the manufacturer for repair or replacement.
 - d. All labor and materials required to remove, repair, replace, or re-install of any component.
- B. The Contractor shall also provide all manufacturers warranties/guarantees associated with installed components of the completed installation.

PART 2 PRODUCTS

2.01 EXTERIOR SURVEILLANCE LOCATIONS

- A. Exterior camera mounting accessories shall of high quality and rated for outdoor environments.
 - 1. AXIS Communications, models as required for the installation of the above noted camera and locations as indicated in the plans and specifications, any substitutions in camera placement to be reviewed and approved by City of Madison Department of Information Technology, with all standard features including the following:
 - a. 3 year AXIS extended warranty option
- B. See plans for camera designations and types.

2.02 INTERIOR SURVEILLANCE LOCATIONS

- A. Interior camera mounting accessories shall of high quality and rated for indoor environments,
 - 1. AXIS Communications, models as required for the installation of the above noted camera and locations as indicated in the plans and specifications, any substitutions in camera placement to be reviewed and approved by City of Madison Department of Information Technology, with all standard features including the following:
 - a. 3 year AXIS extended warranty option
 - b. Surface mount as per plans
 - c. Drop ceiling mount as per plans
- B. All drop ceiling mount locations shall include tile bridge supports
 - 1. ERICO, SCMKC Security Camera Mounting Kit
 - 2. Pre-approved equal
- C. See plans for camera designations and types.

PART 3 - EXECUTION

3.01 COOPERATION OF THE CONTRACTOR

- A. All line voltage installations that may be required under this specification shall be installed by the Electrical Contractor. Power shall come from the nearest power panel where the equipment is being installed. Label boxes with panel and circuit number for future reference. Installation shall include any fire stopping as required by code.

- B. Data cables shall be installed by the Cabling Contractor as required for this installation. Data cables shall come from the nearest Telecom Room where the equipment is being installed. Installation shall include any fire stopping as required by code.
- C. The Contractor shall install all security cameras, mounting hardware, boxes and other equipment necessary for a complete installation of the surveillance system.

3.02 EXTERIOR INSTALLATIONS

- A. Provide and install all camera mounting hardware, fastening hardware and anchors as needed for a strong, secure and stable installation as necessary for the building materials being mounted to.
- B. Provide and install a high grade clear silicone sealant around all mounting hardware.
- C. Provide sufficient cable and install a drip loop if cable is exposed outside of the mounting hardware.
- D. Label camera end of data cable with permanent data tag indicating switch location connection ID.
- E. Label switch end of data cable with permanent data tag indicating camera location.
- F. Provide surge protection at each camera.

3.03 INTERIOR INSTALLATIONS

- A. Provide and install all camera mounting hardware, fastening hardware and anchors as needed for a strong, secure and stable installation as necessary for the building materials being mounted to.
- B. Install tile bridge supports at all drop ceiling locations.
- C. Label camera end of data cable with permanent data tag indicating switch location connection id.
- D. Label switch end of data cable with permanent data tag indicating camera location.

3.04 INSTALLATION TESTING AND ACCEPTANCE

- A. Any required system programming (by CoM-IT or Contractor) shall be completed prior to doing any installation testing and acceptance.
- B. It is the sole responsibility of the Contractor to notify CoM-IT no less than two (2) weeks in advance of completing the installation to coordinate all final testing of the completed system.
- C. The Contractor and CoM-IT shall test each surveillance camera installation to ensure the installed components work per the specifications.
 - 1. All installed components shall be inspected as follows:
 - a. All connections are tight, exterior installations are weather proof with clear silicone sealant.
 - b. All components are clean and free of dust, finger prints and other general dirt.
 - c. Camera lenses and domes are clean and free of lint, dust and finger prints.
 - d. Cameras are free to rotate.
 - e. All network connectivity is complete and installed properly.
 - 2. Each camera installation at the project site shall be tested from an off site computer to ensure all pan/tilt/zoom features, focus and other functions are fully operational.
- D. A completed and accepted installation shall pass all of the above tests for each installed camera location.
- E. The warranty period for the completed and accepted installation shall not begin until the date of the accepted general contract. The Contractor shall coordinate this date with the General Contractor.
- F. Provide Owner/User training based on the Genetec software.
- G. Meet with the Owner/User to check camera views and adjust camera views as needed.

END OF SECTION

SECTION 28 31 11
BUILDING INTRUSION DETECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Alarm control unit.
- B. Keypads.
- C. Initiating devices.
- D. Alarm notification appliances.
- E. Accessories.

1.02 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- B. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 609 - Local Burglar Alarm Units and Systems Current Edition, Including All Revisions.
- D. UL 634 - Connectors and Switches for Use with Burglar-Alarm Systems Current Edition, Including All Revisions.
- E. UL 1076 - Proprietary Burglar Alarm Units and Systems Current Edition, Including All Revisions.
- F. UL 1610 - Central-Station Burglar-Alarm Units Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate compatibility of devices for the installed locations with work provided under other sections or by others.
 - 2. Coordinate the placement of sensors and keypads with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 3. Coordinate the work with other installers to provide communication lines required for alarm control unit connection to central station.
 - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Preinstallation Meeting: Conduct meeting with facility representative and other related equipment manufacturers to discuss intrusion detection system interface requirements.
- C. Sequencing:
 - 1. Do not install sensors and keypads until final surface finishes and painting are complete.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each system component. Include ratings, configurations, standard wiring diagrams, dimensions, finishes, service condition requirements, and installed features.
- C. Shop Drawings: Include plan views indicating locations of system components and proposed size, type, and routing of conduits and/or cables. Include system interconnection schematic diagrams. Include requirements for interface with other systems.
- D. Certify that proposed system design and components meet or exceed specified requirements.
- 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 operation of product.

- F. Manufacturer's detailed field testing procedures.
- G. Field quality control test reports.
- H. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
- I. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- J. Project Record Documents: Record actual locations of system components and installed wiring arrangements and routing.
- K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Fuses: Two for each type and size installed.

1.05 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. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with intrusion detection systems of similar size, type, and complexity and providing contract maintenance service as a regular part of their business; authorized representative of control unit manufacturer.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- B. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.07 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.08 WARRANTY

- A. See Section 01 77 00 - Closeout Submittals for City of Madison additional warranty requirements.
- B. Provide minimum two year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 INTRUSION DETECTION SYSTEM REQUIREMENTS

- A. Provide new intrusion detection system consisting of all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.
- B. Alarm Control Unit: New addressable alarm control panel located as indicated.
- C. Combination fire/intrusion systems are not permitted.
- D. Keypads: Located as indicated.
 - 1. Within 6 feet of main building entrance.
- E. Initiating Device Requirements:

1. Protected Premises: Entire building as indicated.
 2. Wire magnetic contacts provided by hardware section to monitor opened/closed position for:
 - a. All overhead doors.
- F. Alarm Notification and Reporting Requirements:
1. Activate alarm notification at alarm control unit and associated keypads/annunciators with appropriate zone information displayed.
 2. Transmit alarm report to listed remote central station under contract with facility.
 - a. Primary Communication Means: Telephone line (digital alarm communicator).
- G. Provide products listed, classified, and labeled as suitable for the purpose intended.
1. Local Alarm Units and Systems: Listed and labeled as complying with UL 609.
 2. Central Station Alarm Units: Listed and labeled as complying with UL 1610.
 3. Proprietary Alarm Units and Systems: Listed and labeled as complying with UL 1076.
- H. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B, consumer application.

2.02 ALARM CONTROL UNIT

- A. Manufacturers:
1. Conventional (Non-Addressable) Alarm Control Panel:
 - a. Bosch Security Systems: www.boschsecurity.us/#sle.
 - b. Digital Security Controls (DSC); a brand of Tyco International: www.dsc.com/#sle.
 - c. Honeywell International, Inc: www.security.honeywell.com/#sle.
- B. Alarm Control Panel: Modular construction.
1. Enclosure: Lockable; provide tamper protection.
 2. Power Supply:
 - a. Primary Power: 120 VAC; provide suitable transformer/power supply; supervised for loss of AC power.
 - b. Secondary Power: Standby battery; provide suitable capacity for minimum standby time required by listing requirements, applicable codes, and authority having jurisdiction, but not less than four hours; provide suitable battery charger; supervised for low battery condition; protected from accidental reversal of battery leads.
- C. Alarm Initiating Circuits: Supervised.
1. Hardwired Zones: Supports both normally closed and normally open conventional (non-addressable) initiating devices.
 2. Addressable Zones: Supports addressable initiating devices and modules using multiplexed polling loops.
- D. Alarm Notification Circuits: Supervised.
- E. Communications Interfaces: Supervised.
1. Supports system reporting to central station receivers via integral interface or accessory interface modules using:
 - a. Telephone lines.
- F. Keypads: Supervised.
- G. Peripheral Devices: Supervised; provide tamper protection.
- H. Output Relays:
1. Relay Modules: Form C relays (normally open and normally closed); provide tamper protection.
 2. Programmable to respond to system events, according to defined scheduling, or by manual activation from keypad.
- I. User Codes:
1. Each user code to be individually assignable to any defined authority level for configurable access to system features and functions.

J. Partitions:

1. Each partition to operate independently with individually programmable annunciation, control, and reporting functions.
2. Supports common partition shared by other assigned partitions.
3. Each zone to be individually assignable to any partition.
4. Each keypad to be individually assignable to any partition.
5. Each output relay to be individually assignable to any partition.
6. Each user code to be individually assignable to any partition.
7. Provide these partitions:
 - a. Library.
 - b. Parks.
 - c. Fire alarm control unit.

K. Scheduling:

1. Provide time/calendar-based scheduling capability for automated system control.
2. Supports open/close schedules for control of arming/disarming and reporting.
3. Supports timed events including, but not limited to:
 - a. Point bypass/unbypass.
 - b. Relay activate/deactivate.

L. Event Log:

1. Stores system events including time, date, partition, zone, and user code where applicable.
2. Supports viewing of event log on keypads.
3. Supports viewing of event log on remote PC.
4. Supports printing of event logs on local printer.
5. Minimum Number of Events Stored: Equivalent to basis of design.

M. Features:

1. Capable of being programmed locally or remotely.
2. Capable of being armed via key switch.

2.03 KEYPADS

- A. Manufacturer: Same as manufacturer of alarm control unit.
- B. Provides interface to alarm control unit for system control and remote annunciation.
- C. Provides visual notification of system status and zone information.
- D. Provides audible notification to indicate system status, entry/exit delay, and alarm situations; provide separate distinguishable sounds for alarm and trouble conditions.
- E. Keypad Type: Only LCD or graphic touch screen keypads are acceptable. Do not use LED keypads.
- F. Graphic Touch Screen Keypads: Displays system status and zone information using plain English on graphic display; touch screen interface.
- G. LCD Keypads: Displays system status and zone information using plain English on alphanumeric display; illuminated keys.

2.04 INITIATING DEVICES

- A. Manufacturers: Same as manufacturer of alarm control units where possible.
- B. General Requirements:
 1. Provide devices suitable for intended application and location to be installed.
 2. Outdoor Units: Weather resistant, suitable for outdoor use.
 3. Addressable Systems:
 - a. Addressable Devices: Individually identifiable by control unit.
 - b. Provide suitable addressable modules for connection to conventional (non-addressable) devices and other components that provide a dry closure output.

- C. Contacts:
 - 1. Listed and labeled as complying with UL 634.
 - 2. Magnetic Contacts: Encapsulated reed switch(es) and separate magnet; designed to monitor opened/closed position of doors or windows.
 - a. Use standard security contacts (not balanced magnetic type) unless otherwise indicated.
- D. Wide Field Motion Detectors
- E. Wireless Diress Buttons

2.05 ACCESSORIES

- A. Provide components as indicated or as required for connection of alarm control unit to devices and other systems indicated.
- B. Provide cables as indicated or as required for connections between system components.
- C. Provide end-of-line resistors (EOLR) as required for supervision of hardwired zones.

PART 3 EXECUTION

3.01 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 branch circuit wiring installation is completed, tested, and ready for connection to system.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Wiring Method: Unless otherwise indicated, use cables (not in conduit).
 - 1. Use listed plenum rated cables in spaces used for environmental air.
 - 2. Install wiring in conduit where required for rough-in, where required by authority having jurisdiction, and where exposed to damage.
 - 3. Conduit: Comply with Section 26 05 33.13.
 - 4. Conceal all cables unless specifically indicated to be exposed.
 - 5. Route exposed cables parallel or perpendicular to building structural members and surfaces.
- D. Provide grounding and bonding in accordance with Section 26 05 26.
- E. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- F. Identify system wiring and components in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- 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. Prepare and start system in accordance with manufacturer's instructions.
- D. Inspection and testing to include, at a minimum:
 - 1. Test each initiating device for proper response by alarm control unit.
 - 2. Test for proper operation of alarm notification appliances.
 - 3. Test for proper operation of output relays.

4. Test for proper operation of communication interfaces and central station reporting.
 5. Test for proper interface with other systems.
- E. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

3.04 ADJUSTING

- A. Program system parameters according to requirements of Owner.

3.05 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or make adjustments as directed.
- B. Training: Train Owner's personnel on operation, adjustment, and maintenance of 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. Instructor: Manufacturer's authorized representative.
 4. Location: At project site.

3.07 PROTECTION

- A. Protect installed system components from subsequent construction operations.

END OF SECTION

**SECTION 28 46 00
FIRE DETECTION AND ALARM**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire alarm system design and installation, including all components, wiring, and conduit.
- B. Transmitters for communication with supervising station.
- C. Circuits from protected premises to supervising station, including conduit.
- D. Maintenance of fire alarm system under contract for specified warranty period.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping: Materials and methods for work to be performed by this installer.
- B. Section 08 71 00 - Door Hardware: Electrically operated locks and door holder devices to be monitored and released by fire alarm system.
- C. Section 21 13 00 - Fire-Suppression Sprinkler Systems: Supervisory, alarm, and actuating devices installed in sprinkler system.
- D. Section 23 33 00 - Air Duct Accessories: Smoke dampers monitored and controlled by fire alarm system.

1.03 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines current edition.
- B. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- 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. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 72 - National Fire Alarm and Signaling Code Most Recent Edition Cited by Referring Code or Reference Standard.
- F. NFPA 76 - Standard for the Fire Protection of Telecommunications Facilities 2020.
- G. UL 268 - Standard for Smoke Detectors for Fire Alarm Systems Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Proposal Documents: Submit the following with cost/time proposal:
 - 1. NFPA 72 "Record of Completion", filled out to the extent known at the time.
 - 2. Manufacturer's detailed data sheet for each control unit, initiating device, and notification appliance.
 - 3. Certification by Contractor that the system design will comply with Contract Documents.
 - 4. Proposed maintenance contract.
- C. Drawings must be prepared. Using AutoCAD 2023
- D. Evidence of designer qualifications.
- E. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
 - 1. Copy (if any) of list of data required by authority having jurisdiction.
 - 2. NFPA 72 "Record of Completion", filled out to the extent known at the time.

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3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
 4. System zone boundaries and interfaces to fire safety systems.
 5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
 6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
 7. List of all devices on each signaling line circuit, with spare capacity indicated.
 8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
 9. Air-Sampling Smoke Detection Systems: Include air-sampling pipe network layout with sampling ports identified; include calculations demonstrating compliance with specified requirements.
 10. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
 11. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
 12. Certification by the manufacturer of the control unit that the system design complies with Contract Documents.
 13. Certification by Contractor that the system design complies with Contract Documents.
- F. Evidence of installer qualifications.
- G. Evidence of instructor qualifications; training lesson plan outline.
- H. Evidence of maintenance contractor qualifications, if different from installer.
- I. Inspection and Test Reports:
1. Submit inspection and test plan prior to closeout demonstration.
 2. Submit documentation of satisfactory inspections and tests.
 3. Submit NFPA 72 "Inspection and Test Form," filled out.
- J. Operating and Maintenance Data: See Section 01 78 00 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:
1. Complete set of specified design documents, as approved by authority having jurisdiction.
 2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
 3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
 4. List of recommended spare parts, tools, and instruments for testing.
 5. Replacement parts list with current prices, and source of supply.
 6. Detailed troubleshooting guide and large scale input/output matrix.
 7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
 8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.
- K. Project Record Documents: See Section 01 78 00 for additional requirements; have one set available during closeout demonstration:
1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
 2. "As installed" wiring and schematic diagrams, with final terminal identifications.
 3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.
- L. Closeout Documents:
-

1. Certification by manufacturer that the system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
 2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.
 3. Certificate of Occupancy.
 4. Maintenance contract.
 5. Report on training results.
- M. Maintenance Materials, Tools, and Software: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 60 00 - Product Requirements, for additional provisions.
 2. Furnish spare parts of same manufacturer and model as those installed; deliver in original packaging, labeled in same manner as in operating and maintenance data and place in spare parts cabinet.
 3. In addition to the items in quantities indicated in PART 2, furnish the following:
 - a. All tools, software, and documentation necessary to modify the fire alarm system using Owner's personnel; minimum modification capability to include addition and deletion of devices, circuits, and zones, and changes to system description, operation, and evacuation and instructional messages.
 - b. One copy, on CD-ROM, of all software not resident in read-only-memory.

1.05 QUALITY ASSURANCE

- A. Copies of Design Criteria Documents: Maintain at the project site for the duration of the project, bound together, an original copy of NFPA 72, the relevant portions of applicable codes, and instructions and guidelines of authorities having jurisdiction; deliver to Owner upon completion.
- B. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer, with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.
- C. Installer Qualifications: Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
 2. Installer Personnel: At least 2 years of experience installing fire alarm systems.
 3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.
 4. Contract maintenance office located within 50 miles of project site.
 5. Certified in the State in which the Project is located as fire alarm installer.
- D. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
- E. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.

1.06 WARRANTY

- A. See Section 01 77 00 - Closeout Submittals for City of Madison additional warranty requirements.
- B. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after date of Substantial Completion.
- C. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Alarm Control Units and Accessories - Basis of Design: Notifier.
- B. Fire Alarm Control Units and Accessories - Other Acceptable Manufacturers:
 - 1. Honeywell Security & Fire Solutions/Gamewell-FCI: www.gamewell-fci.com/#sle.
 - 2. Honeywell Security & Fire Solutions/Fire-Lite: www.firelite.com/#sle.
 - 3. Honeywell Security & Fire Solutions/Notifier: www.notifier.com/#sle.
 - 4. Honeywell Security & Fire Solutions/Silent Knight: www.silentknight.com/#sle.
 - 5. Honeywell Security & Fire Solutions/Vista: www.security.honeywell.com/#sle.
 - 6. National Time & Signal: www.natsco.net/#sle.
 - 7. Potter Electric Signal Company: www.pottersignal.com/#sle.
 - 8. Siemens Building Technologies, Inc: www.usa.siemens.com/#sle.
 - 9. Simplex, a brand of Johnson Controls: www.simplex-fire.com/#sle.
 - 10. Provide control units made by the same manufacturer.
- C. Initiating Devices and Notification Appliances:
 - 1. Honeywell Security & Fire Solutions/Gamewell-FCI: www.gamewell-fci.com/#sle.
 - 2. Honeywell Security & Fire Solutions/Fire-Lite: www.firelite.com/#sle.
 - 3. Honeywell Security & Fire Solutions/Notifier: www.notifier.com/#sle.
 - 4. Honeywell Security & Fire Solutions/Silent Knight: www.silentknight.com/#sle.
 - 5. Honeywell Security & Fire Solutions/Vista: www.security.honeywell.com/#sle.
 - 6. National Time & Signal: www.natsco.net/#sle.
 - 7. Siemens Building Technologies, Inc: www.sbt.siemens.com/#sle.
 - 8. Simplex, a brand of Johnson Controls: www.simplex-fire.com/#sle.
 - 9. Same manufacturer as control units.
- D. Substitutions: See Section 01 60 00 - Product Requirements.
 - 1. For other acceptable manufacturers of control units specified, submit product data showing equivalent features and compliance with Contract Documents.
 - 2. For substitution of products by manufacturers not listed, submit product data showing features and certification by Contractor that the design will comply with Contract Documents.

2.02 FIRE ALARM SYSTEM

- A. Fire Alarm System: Provide a new automatic fire detection and alarm system:
 - 1. Provide all components necessary, regardless of whether shown in Contract Documents or not.
 - 2. Protected Premises: Entire building shown on drawings.
 - 3. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
 - a. ADA Standards.
 - b. The requirements of the local authority having jurisdiction .
 - c. Applicable local codes.
 - d. Contract Documents (drawings and specifications).
 - e. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.
 - 4. Evacuation Alarm: Multiple smoke zones; allow for evacuation notification of any individual zone or combination of zones, in addition to general evacuation of entire premises.
 - 5. Voice Notification: Provide emergency voice/alarm communications with multichannel capability; digital.
 - 6. General Evacuation Zones: Each smoke zone is considered a general evacuation zone unless otherwise indicated, with alarm notification in all zones on the same floor, on the floor above, and the floor below.

- B. Supervising Stations and Fire Department Connections:
 - 1. Public Fire Department Notification: By on-premises supervising station.
 - 2. On-Premises Supervising Station: Existing proprietary station operated by Owner, located at .
 - 3. Means of Transmission to On-Premises Supervising Station: Directly connected noncoded system.
- C. Circuits:
 - 1. Initiating Device Circuits (IDC): Class B, Style A.
 - 2. Signaling Line Circuits (SLC) Within Single Building: Class B, Style 0.5.
 - 3. Notification Appliance Circuits (NAC): Class B, Style W.
- D. Spare Capacity:
 - 1. Initiating Device Circuits: Minimum 25 percent spare capacity.
 - 2. Notification Appliance Circuits: Minimum 25 percent spare capacity.
 - 3. Fire Alarm Control Units: Capable of handling all circuits utilized to capacity without requiring additional components other than plug-in control modules.
- E. Power Sources:
 - 1. Primary: Dedicated branch circuits of the facility power distribution system.
 - 2. Secondary: Storage batteries.
 - 3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.
 - 4. Each Computer System: Provide uninterruptible power supply (UPS).

2.03 FIRE SAFETY SYSTEMS INTERFACES

- A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:
 - 1. Sprinkler water control valves.
 - 2. Dry-pipe sprinkler system pressure.
 - 3. Dry-pipe sprinkler valve room low temperature.
- B. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:
 - 1. Sprinkler water flow.
 - 2. Duct smoke detectors.
- C. HVAC:
 - 1. Duct Smoke Detectors: Close dampers indicated; shut down air handlers indicated.
- D. Doors:
 - 1. Smoke Barrier Door Magnetic Holders: Release upon activation of smoke detectors in smoke zone on either side of door, upon alarm from manual pull station on same floor, and upon sprinkler activation on same floor. Refer to Section 08 71 00.

2.04 COMPONENTS

- A. General:
 - 1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
 - 2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.
- B. Fire Alarm Control Units: Analog, addressable type; listed, classified, and labeled as suitable for the purpose intended.
- C. Addressable Fire Alarm Control Unit - Basis of Design: Notifier.
- D. Master Control Unit: As specified for Basis of Design above, or equivalent.
- E. Remote Annunciators: Notifier.
- F. Initiating Devices:
 - 1. Addressable Systems:
 - a. Addressable Devices: Individually identifiable by addressable fire alarm control unit.

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- b. Provide suitable addressable interface modules as indicated or as required for connection to conventional (non-addressable) devices and other components that provide a dry closure output.
 - 2. Manual Pull Stations: Notifier.
 - 3. Smoke Detectors: Notifier.
 - 4. Duct Smoke Detectors: Notifier.
 - 5. Air-Sampling Smoke Detection Systems:
 - a. Design and provide smoke detection system suitable for application and coverage area indicated, consisting of smoke detector unit with aspirator/fan that continuously draws air into sensing chamber through connected sampling pipe network and associated sampling ports.
 - b. Comply with NFPA 72 and list and label as complying with UL 268.
 - c. Comply with applicable requirements of NFPA 76 for Very Early Warning Fire Detection (VEWFD).
 - d. Detector Unit:
 - 1) Sensitivity: Programmable; capable of meeting NFPA 76 requirements for Very Early Warning Fire Detection (VEWFD).
 - 2) Smoke Detection Method: Provide detector units employing laser-based light scattering mass detection.
 - 3) Alarm Levels: Programmable; as indicated or as required to perform alert, pre-alarm action, and alarm functions; minimum of three.
 - 4) Minimum Number of Output Relays Supported: Equivalent to basis of design.
 - 5) Display: Provides local annunciation of detector trouble and alarm status.
 - e. Sampling Pipe Network:
 - 1) Use manufacturer's recommended sampling pipe and fittings; plenum rated; identified in accordance with NFPA 72.
 - 2) Designed using manufacturer's product-specific design software or based on manufacturer's pre-engineered design suitable for the application.
 - G. Notification Appliances:
 - 1. Bells: Notifier.
 - a. Provide 1 extra.
 - 2. Speakers: Notifier.
 - a. Provide 1 extra.
 - 3. Strobes: Notifier.
 - a. Provide 1 extra.
 - H. Circuit Conductors: Copper or optical fiber; provide 200 feet extra; color code and label.
 - I. Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.
 - J. Locks and Keys: Deliver keys to Owner.
 - K. Instruction Charts: Printed instruction chart for operators, showing steps to be taken when a signal is received (normal, alarm, supervisory, and trouble); easily readable from normal operator's station.
 - 1. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
 - 2. Provide one for each control unit where operations are to be performed.
 - 3. Obtain approval of Owner prior to mounting; mount in location acceptable to Owner.
 - 4. Provide extra copy with operation and maintenance data submittal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with applicable codes, NFPA 72, NFPA 70, and Contract Documents.
 - B. Conceal all wiring, conduit, boxes, and supports where installed in finished areas.
-

- C. Obtain Owner's approval of locations of devices, before installation.
- D. Install instruction cards and labels.

3.02 INSPECTION AND TESTING FOR COMPLETION

- A. Notify Owner 7 days prior to beginning completion inspections and tests.
- B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
- C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.
- D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.
- E. Provide all tools, software, and supplies required to accomplish inspection and testing.
- F. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.
- G. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.
- H. Diagnostic Period: After successful completion of inspections and tests, Operate system in normal mode for at least 14 days without any system or equipment malfunctions.
 - 1. Record all system operations and malfunctions.
 - 2. If a malfunction occurs, start diagnostic period over after correction of malfunction.
 - 3. Owner will provide attendant operator personnel during diagnostic period; schedule training to allow Owner personnel to perform normal duties.
 - 4. At end of successful diagnostic period, fill out and submit NFPA 72 "Inspection and Testing Form."

3.03 OWNER PERSONNEL INSTRUCTION

- A. Provide the following instruction to designated Owner personnel:
 - 1. Hands-On Instruction: On-site, using operational system.
 - 2. Classroom Instruction: Owner furnished classroom, on-site or at other local facility.
 - 3. Factory Instruction: At control unit manufacturer's training facility.
- B. Administrative: One-hour session(s) covering issues necessary for non-technical administrative staff; classroom:
 - 1. Initial Training: 1 session pre-closeout.
- C. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:
 - 1. Initial Training: 1 session pre-closeout.
 - 2. Refresher Training: 1 session post-occupancy.
- D. Detailed Operation: Two-hour sessions for engineering staff; assume NICET level I qualifications or equivalent; combination of classroom and hands-on:
 - 1. Initial Training: 1 session pre-closeout.
- E. Maintenance Technicians: Detailed training for electrical technicians, on programming, maintaining, repairing, and modifying; factory training:
 - 1. Initial Training: One 3-day session, pre-closeout.
- F. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.
- G. Provide means of evaluation of trainees suitable to type of training given; report results to Owner.

3.04 CLOSEOUT

- A. Closeout Demonstration: Demonstrate proper operation of all functions to Owner.

1. Be prepared to conduct any of the required tests.
 2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
 3. Have authorized technical representative of control unit manufacturer present during demonstration.
 4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
 5. Repeat demonstration until successful.
- B. Occupancy of the project will not occur prior to Substantial Completion.
- C. Substantial Completion of the project cannot be achieved until inspection and testing is successful and:
1. Specified diagnostic period without malfunction has been completed.
 2. Approved operating and maintenance data has been delivered.
 3. Spare parts, extra materials, and tools have been delivered.
 4. All aspects of operation have been demonstrated to Owner.
 5. Final acceptance of the fire alarm system has been given by authorities having jurisdiction.
 6. Occupancy permit has been granted.
 7. Specified pre-closeout instruction is complete.
- D. Perform post-occupancy instruction within 3 months after Substantial Completion.

3.05 MAINTENANCE

- A. See Section 01 77 00 - Closeout Procedures, for City of Madison additional requirements relating to maintenance service.
- B. Provide to Owner, at no extra cost, a written maintenance contract for entire manufacturer's warranty period, to include the work described below.
- C. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
 2. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.
 3. Record keeping required by NFPA 72 and authorities having jurisdiction.
- D. Provide trouble call-back service upon notification by Owner:
1. Provide on-site response within 2 hours of notification.
 2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
 3. 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.
- E. Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.
- F. Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Owner's representative upon completion of site visit.
- G. Comply with Owner's requirements for access to facility and security.

END OF SECTION

SECTION 31 02 00
GENERAL REQUIREMENTS FOR SITEWORK

PART 1 GENERAL

1.01 SUMMARY

- A. This Section governs only technical specifications related to site work construction.
- B. Section Includes:
 - 1. Definitions.
 - 2. Field Engineering.
 - 3. Pre-installation Meeting.
 - 4. Demonstration and Training Meeting.
 - 5. Submittal Procedures.
 - 6. Traffic Control Plan.
 - 7. Quality Control Requirements.
 - 8. Erosion and Sediment Control.
 - 9. Proposed Products List.
 - 10. Product Requirements.
 - 11. Project Closeout Procedures.
- C. Related Divisions:
 - 1. Division 02 – Existing Conditions.
 - 2. Division 31 – Earthwork.
 - 3. Division 32 – Exterior Improvements.
 - 4. Division 33 – Utilities.

1.02 DEFINITIONS

- A. Field Engineering: Contractor's establishment of elevations, lines, and levels as indicated on Drawings, utilizing recognized engineering survey practices.
 - B. Pre-installation Meeting: Meeting to discuss a product or material, typically complex in nature, and review manufacturer's precautions, restrictions, and installation procedures.
 - C. Demonstration and Training Meeting: Contractor and/or manufacturer representative administered demonstration and training sessions for Owner for each portion of equipment and products that are required to have training in proper operation and maintenance.
 - D. Submittal Procedures: Specified requirements regarding procedures related to submission of product data, Shop Drawings, manufacturer's certificates, and substitutions.
 - E. Traffic Control Plan: Plan developed consistent with Manual on Uniform Traffic Control Devices (MUTCD).
 - F. Quality Control: Inspection, analysis, and other relevant actions taken to provide control over what is being done, manufactured, or fabricated, so that a desirable level of quality is achieved and maintained during duration of the Work.
 - G. Erosion and Sediment Control: Enforcement of state law and city or county ordinance for erosion and sediment control including installation, maintenance, and regular Contractor inspection and repair.
 - H. Proposed Product List: Prepared listing of all materials and products intended to be used for site work related to sewer and water utilities, aggregates, and soils, and pavement mix designs.
 - I. Product Requirements: Product information regarding manufacturer's data, preparation, fabrication, conveying and erection of Work including material, machinery, components, equipment, fixtures, and systems incorporated in Work.
 - J. Project Closeout Procedures: Process that provides acceptance of project by Owner and Engineer/Architect including verification and documentation of required project records, and retention of other essential project documentation.
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1.03 FIELD ENGINEERING

- A. Employ Land Surveyor registered in State of Wisconsin and acceptable to Owner.
- B. Contractor shall locate and protect survey control and reference points. Promptly notify Owner and Construction Manager of discrepancies discovered.
- C. Control datum for survey is that established by Owner provided survey shown on Drawings.
- D. Verify setbacks and easements; confirm drawing dimensions and elevations.
- E. Provide required field engineering services. Establish elevations, lines, and levels, utilizing recognized engineering survey practices.
- F. Submit copy of site drawing and certificate signed by registered Land Surveyor certifying elevations and locations of the Work are in conformance with Contract Documents.
- G. Maintain complete and accurate log of control and survey work as Work progresses.
- H. On completion of foundation walls and major site improvements, prepare certified survey illustrating dimensions, locations, angles, and elevations of building construction and site utilities work.
- I. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- J. Promptly report to Owner and Construction Manager loss or destruction of reference point or relocation required because of changes in grades or other reasons.
- K. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Owner and Construction Manager.
- L. A Registered Land Surveyor shall replace damaged property corners at Contractor's expense.

1.04 PREINSTALLATION MEETING

- A. When required in individual specification sections, convene preinstallation meeting at Project site prior to commencing work of specific section.
- B. Require attendance of parties directly affecting, or affected by, Work of specific section.
- C. Notify Owner, Engineer/Architect and Construction Manager four (4) days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 - 1. Review conditions of installation, preparation and installation procedures.
 - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two (2) days after meeting to participants, with copies to Owner, Engineer/Architect and Construction Manager and those affected by decisions made.

1.05 DEMONSTRATION AND TRAINING MEETING

- A. Contractor shall schedule and administer demonstration and training sessions for Owner for each portion of equipment and products that are required to have training in proper operation and maintenance.
- B. Contractor shall schedule representatives of equipment manufacturer to attend demonstration and training sessions to provide additional information as necessary.

1.06 SUBMITTAL PROCEDURES

- A. Contractor shall provide Engineer electronic PDF copies of specific submittal information regarding products and materials of this specification section with extended permission of Architect.
- B. Submit Shop Drawings and product data in electronic PDF copies covering identified equipment and materials that will become a permanent part of Work to Engineer/Architect for review.
- C. Electronically submit material information, product data, and shop drawings in PDF format to contact agreed upon in project kickoff meeting.

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- D. Shop Drawings and product data shall include drawings, descriptive information, and sufficient detail to show kind, size, arrangement, and operation of component materials and devices needed for installation and coordination with other materials and equipment.
 - E. All submittals, regardless of origin, shall be stamped with approval of Contractor and identified with name of the Project, Contractor's name, and references to applicable specification sections and Drawings.
 - F. Each submittal shall indicate intended use of item in Work. When manufacturer data sheets are submitted, clearly identify applicable items and cross out inapplicable data.
 - G. Manufacturer's data sheets shall be current and include issue number and date.
 - H. Contractor's stamp of approval is a representation to Engineer/Architect that Contractor accepts full responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data, and that Contractor reviewed and coordinated each submittal with requirements of the Work.
 - I. Contractor shall accept full responsibility for completeness of each submission. When an item consists of components from several sources, Contractor shall submit a complete initial submittal including all components.
 - J. Identify deviations from Specifications and Drawings on each submittal and tabulate in Contractor's letter of transmittal. Such submittals shall indicate details of proposed changes, including modifications to other facilities that may result from deviation, and required piping and wiring diagrams.
 - K. Submit electronic PDF copies of each drawing and necessary data to Engineer/Architect. Engineer/Architect will return two marked copies to Contractor.
 - L. Engineer/Architect will not accept submittals from anyone but Contractor or Architect.
 - M. Submittals shall be consecutively numbered in direct sequence of submittal and without division by subcontracts or trades.
 - N. Review of Shop Drawings and Product Data:
 - 1. Engineer/Architect's review of Shop Drawings and product data will cover only general conformity to Drawings and Specifications, external connections, and dimensions that affect layout. Engineer/Architect's review does not indicate a thorough review of all dimensions, quantities, and details of material, equipment, device, or item shown.
 - 2. Engineer/Architect's review shall not relieve Contractor of Contractor's responsibility for errors, omissions, or deviations in drawings and data, or of sole responsibility for compliance with the Work.
 - 3. Engineer/Architect's submittal review period shall be a maximum of seven (7) days from date of submittal or resubmittal.
 - 4. When Shop Drawings and data are returned marked "NOT ACCEPTABLE" or "RETURNED FOR CORRECTION", Contractor shall make corrections as noted by Engineer/Architect and resubmit corrected copy.
 - 5. When Shop Drawings and product data are returned marked "EXCEPTIONS NOTED" or "APPROVED AS SUBMITTED", no additional copies need be submitted unless requested by Engineer/Architect at time of review.
 - O. Re-submittal of Shop Drawings and Product Data:
 - 1. Contractor shall accept full responsibility for completeness of each re-submittal.
 - 2. Contractor shall verify that resubmittal provides all corrected data and additional information previously requested by Engineer/Architect.
 - 3. When corrected files are re-submitted, Contractor shall indicate in writing revisions made.
 - 4. Requirements specified for initial submittals also apply to re-submittals.
 - 5. Re-submittals shall bear number of first submittal followed by a letter (A, B, etc.) to indicate sequence of re-submittal.
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6. Make re-submittals within seven (7) days of date of letter returning material to be modified or corrected.
- P. Substitutes and "Or-Equal" Items:
 1. Whenever a material or article is specified or described by using a single name of a proprietary product or a single name of a particular manufacturer or vendor, specified item mentioned shall be understood as establishing type, function, and quality desired.
 2. Whenever two or more names of proprietary products or particular manufacturers or vendors are used, it shall be understood that products of one named supplier shall be furnished with no options or substitutions allowed.
 3. Products, materials, or equipment not specified by proprietary name and submitted as a proposed substitute shall be reviewed and approved or rejected by Engineer/Architect.

1.07 TRAFFIC CONTROL PLAN

- A. Submit a traffic control plan for construction in public right-of-way in accordance with the "Manual on Uniform Traffic Control Devices."
- B. Data to be included on a traffic control plan will vary depending upon complexity of project, volume of traffic affected, and roadway geometrics where construction is being performed.
- C. Traffic control plan must clearly depict exact sequence of construction operation(s), construction to be performed, and traveled way that will be utilized by all movements of traffic during each phase of construction.
- D. Multiple phases of construction will require a separate traffic control plan for each different construction phase or operation.

1.08 QUALITY CONTROL REQUIREMENTS

- A. Construction Notification:
 1. Contractor shall be responsible for locating existing underground installations in advance of excavating or trenching by contacting local utility identification agency.
- B. Licenses, Permits, and Certificates:
 1. All licenses, permits, and certificates, required for, and in connection with site and utility work shall be secured by Contractor at their sole cost and expense.
 2. Contractor will be required to pay any permit fees required for utility work.
 3. Contractor shall comply with all requirements and recommendations of authority or authorities issuing license, permit, or certificate.
- C. Easements and Rights-of-Way:
 1. Contractor will confine construction operations to areas designated on Drawings or identified by Owner's Representative or Construction Manager.
 2. Contractor shall use care in placement of construction tools, equipment, excavated materials, pipe materials, and supplies so as to minimize damage to property and minimize interference with the public.
- D. Protection of Property:
 1. Contractor shall protect from damage or injury all property including survey monuments, property markers, and benchmarks. Items damaged shall be replaced or repaired at Contractor's expense.
 2. Locate existing utilities and utility services in advance of excavation and protect against damage. Changes in grade and alignment may be made to Work to avoid conflicts with existing structures if approved by Owner's Representative.
- E. Adjustment of Castings
 1. Adjust castings in accordance with City of Madison Standard Specifications for Public Works Construction, Part II, Article 205 Adjustment of Castings
- F. Reference Standards:

1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to laws or regulations of any governmental authority, whether such reference be specific or by implication, shall mean latest edition of appropriate standard, specification, manual, code, law, or regulation in effect on date of first advertisement for the Work, unless specifically stated otherwise in Contract Documents.
 2. Should there be a conflict in Reference Standards, Contractor shall request clarification from Engineer/Architect before proceeding.
- G. Compaction and Gradation Testing:
1. Contractor shall provide and pay for compaction and gradation testing by an Owner approved independent testing laboratory.
 - a. Make two (2) initial gradation tests for each type of bedding and backfill material, and make one additional gradation test for each additional 500 tons of each material.
 - b. Moisture-density (Proctor) tests and relative density tests on materials, and in-place field density tests, shall be made at intervals determined by Owner's Representative.
 - c. Perform compaction and proof roll testing in accordance with procedures specified in Section 31 23 16 - Utility Trench Excavation, Backfill, and Compaction and Section 32 11 23 - Aggregate Base Course.
- H. Traffic Control - General:
1. Protect streets, roads, highways, and other public thoroughfares that are to be temporarily closed or restricted for traffic flow by effective barricades equipped with operational warning signals.
 2. Locate barricades at nearest intersecting public highway or street on each side of blocked section.
 3. Cover open trenches and other excavations with steel plates and have suitable barricades, signs, and lights to provide adequate protection to the public. Provide obstructions such as material piles and equipment with similar warning signs and lights.
- I. Maintenance of Traffic:
1. Maintain effected traffic areas throughout duration of construction, in accordance with local, state, or federal requirements which govern Work area.
 2. Contractor is responsible for maintaining traffic.
 3. Contractor shall conduct work to minimize interference with traffic, vehicular or pedestrian.
 4. Contractor shall obtain and pay for any permit required by local authority for areas where traffic will be obstructed.
 5. Contractor shall provide and maintain suitable and safe bridges, detours, or other temporary measures for accommodating public and private travel.
 6. Contractor shall provide at least 24 hours notice to owners of private drives before performing Work which would obstruct safe passage by drive owner.
 7. Illuminate barricades and obstructions with warning lights from sunset to sunrise.
 8. Store material storage and perform Work on or alongside public streets and highways to minimize obstruction and inconvenience to public.
- J. Traffic Control Devices:
1. Contractor shall provide barricades, cones, construction warning signs, flagmen, and incidental devices to protect personnel and equipment on the Work site.

1.09 EROSION AND SEDIMENT CONTROL

- A. Comply with requirements specified in Section 01 57 10 - Temporary Erosion and Sediment Control and as indicated on Drawings.

1.10 PROPOSED PRODUCTS LIST

- A. Within seven (7) days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.11 PRODUCT REQUIREMENTS

- A. Products include material, equipment, and systems.
- B. Comply with specifications and referenced standards as minimum requirements.
- C. Components required to be supplied in quantity within a Specification section shall be same, and shall be interchangeable.
- D. Do not use materials and equipment removed from existing structure, except as specifically required or allowed by Contract Documents.
- E. Products Specified by Reference Standards or by Description Only: Furnish any product meeting those standards.
- F. Products Specified by Naming Two (2) or More Manufacturers: Furnish products of one named manufacturer meeting specifications; no options or substitutions allowed.
- G. Products Specified by Naming One (1) or More Manufacturers or with a Provision for Substitutions: Submit a request for substitution of a proposed equal.

1.12 PROJECT CLOSEOUT PROCEDURES

- A. Project Records Documents:
 - 1. Contractor shall maintain, on site, one (1) set of the following record documents:
 - a. Drawings.
 - b. Specifications.
 - c. Approved Shop Drawings.
 - d. Product data.
 - e. Samples.
 - 2. Contractor shall store Record Documents separate from documents used for construction.
 - 3. Contractor shall record actual revisions to the Work and maintain information concurrent with construction progress.
 - 4. Contractor shall legibly mark each item to record actual construction including:
 - a. Measured horizontal and vertical locations of new utilities and existing underground utilities and appurtenances referenced to permanent surface improvements.
 - b. Field changes of dimensions and Drawing details.
 - c. Details not on original Drawings.
 - 5. Submit Record Documents to Owner at Final Inspection, including:
 - a. Project Drawings.
 - b. Survey notes.
 - c. Approved submittals.
 - d. Operation and Maintenance Manuals.

END OF SECTION

**SECTION 31 10 00
SITE CLEARING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Clearing and protection of vegetation.
- B. Removal of existing debris.

1.02 RELATED REQUIREMENTS

- A. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- B. Section 02 41 00 - Demolition: Removal of built elements and utilities.
- C. Section 31 02 00 - General Requirements for Sitework
- D. Section 31 22 00 - Grading: Topsoil removal.
- E. Section 31 23 23 - Fill: Filling holes, pits, and excavations generated as a result of removal operations.
- F. Section 32 00 00 - General Requirements for Sitework
- G. Section 32 93 00 - Plants: Relocation of existing trees, shrubs, and other plants.

PART 2 PRODUCTS -- NOT USED**PART 3 EXECUTION****3.01 SITE CLEARING**

- A. Comply with other requirements specified in Section 01 70 00.
- B. Comply with City of Madison Standard Specifications for Public Works Construction, Part II, Article 204 Clearing and Grubbing
- C. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

3.02 EXISTING UTILITIES AND BUILT ELEMENTS

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Protect existing structures and other elements that are not to be removed.

3.03 VEGETATION

- A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by building structure, paving, playing fields, lawns, and planting beds.
 - B. Do not remove or damage vegetation beyond the disturbance limits indicated on drawings.
 - 1. Exception: Specific trees and vegetation indicated on drawings to be removed.
 - C. Install substantial, highly visible fences at least eight (8) feet high to prevent inadvertent damage to vegetation to remain:
 - 1. At vegetation removal limits.
 - 2. See Section 01 50 00 for fence construction requirements.
 - D. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum disturbance of the subsoil.
 - E. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated.
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1. Chip, grind, crush, or shred vegetation for mulching, composting, or other purposes; preference should be given to on-site uses.
 2. Trees: See Section 31 13 00
 3. Sod: See section 32 93 00
- F. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner.

3.04 DEBRIS

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

**SECTION 31 13 00
SELECTIVE TREE PROTECTION AND REMOVAL**

PART 1 GENERAL

1.01 DESCRIPTION

- A. Protecting existing trees and vegetation from all damage during construction including injury to trunks, branches or roots; selectively removing any trees required to be removed during construction; and pruning existing plant material to remain that is affected by the execution of the work

1.02 RELATED WORK AND REQUIREMENTS

- A. Applicable provisions of Division 01 shall govern Work of this Section.
- B. Section 01 57 13 "Temporary Erosion and Sediment Control" for erosion materials coordination.
- C. Section 31 10 00 "Site Clearing" for coordination with site clearing operations.
- D. Section 31 22 00 "Grading" for coordination with excavation and subgrade preparation work.
- E. Section 32 92 19 "Seeding" for seeded lawns and native plant mixes.
- F. Section 32 92 23 "Sodding" for sodded lawns.
- G. Section 32 93 00 "Plants" for project plantings and at-grade landscape materials.
- H. City of Madison Standard Specifications for Public Works Construction, Section 107.13, Tree Protection Specification.

1.03 DEFINITIONS

- A. Arborist or Certified Arborist: As referenced herein in all "arborists" or "certified arborists" shall be at minimum an ISA Certified Arborist or and ASCA Registered Consulting Arborist unless otherwise specified.
- B. Caliper: Diameter of a trunk measured by a diameter tape at 4'-6" above the ground or DBH (diameter at breast height). This is a standard as defined by the ISA – International Society for Arboriculture.
- C. Tree Protection Zone (TPZ): Area surrounding individual trees or groups of trees to be protected during construction and defined by calculating the critical root radius (crr). The crr is the tree trunk caliper (diameter) at 4'-6" above the ground multiplied by 1.5, the result expressed in feet. The root protection zone is the outside edge of a concentric circle with the crr as its radius extending from the trunks of the tree or as indicated on the drawings, whichever is larger. Note that a tree/plant sensitivity or tolerance to construction disturbance may require a larger TPZ area than the area based on this calculation. This is to ensure that both the feeder and structural support roots are undamaged to maintain the integrity of the tree.
- D. Trees: Within this Section, "trees", wherever the word used, may mean an individual tree or may mean all vegetation (shrubs, groundcovers, grasses, and/or other plants) to be protected.

1.04 SUBMITTALS

- A. Tree Pruning Schedule: Submit, in writing, to the Landscape Architect a schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction. Include description of pruning to be performed and maintenance following pruning. Submit Pruning and Removals Schedule to the Landscape Architect a minimum of 10 working days in advance of work being performed and obtain written approval of schedule and extents prior to the start of the work. Include in the schedule any trees within the City right-of-way that may require construction clearance or other pruning.

- B. Additional Tree Removals Schedule and Field Tagging Removals: Identify any additional trees within the project site or right-of-way that require removal for the normal course of construction or any unforeseen construction modifications PRIOR to their removal. Indicate a complete inventory of intended additional removals (tree species, tree size, quantity of each type of tree), location of tree on a site plan mark-up, intended timing of removals, and any additional information necessary to convey the extent of the impact and the reason for the removals.
 - 1. Submit the Additional Removals Schedule a minimum of 20 working days in advance of removals and obtain written approval to proceed from the Landscape Architect and/or a City of Madison Forestry Representative if trees are in the right-of-way.
 - 2. Additional removals within the right-of-way will require a permit to be issued by City Forestry. In addition, any removals that were not included in the approved development plan will require a minimum of 72-hour review period which shall include the notification of the Alderperson within whose district is affected by the additional street tree removal(s) prior to a tree removal permit being issued.
- C. Qualification Data: Submit qualification data for tree service firm and arborist. Firm must be located within 1-hours' drive of the project site, be in business for no less than five years, and be pre-approved to perform tree removals, pruning and planting work for the City of Madison.

1.05 QUALITY ASSURANCE

- A. Coordination: Contact City Forestry (608-266-4816) representatives at least ten (10) working days in advance of any tree removal operations, if required by the project, to request field tagging of material to be removed; all actual removals work to be performed by the Contractor, however City coordination will be required to confirm final list of trees to be removed via tagging.
- B. Site Tree Protection and Removals Plan: Tree protection fencing is indicated in the working drawings. Tree protection zones indicated are considered minimums; provide additional protection measures as necessary to protect the short and long-term health of each individual existing tree that is intended to remain on site and/or in City right-of-way.
- C. Arborist Qualifications: An arborist certified by ISA-International Society of Arboriculture and possessing knowledge and prior work history on City of Madison right-of-way and/or parks projects.
- D. Tree Pruning Standard: Comply with ANSI A300 Pruning Standards.
- E. Oak Wilt Prevention: Wisconsin Department of Natural Resources Forestry Division Publication PUB-FR-127 2009.
- F. Tree Protection Standard: Reference and Comply with "Arboriculture: Integrated Management of Landscape Trees, Shrubs and Vines. Harris, Clark and Matheny. 4th Edition, (2003), Sections: 7 – Modifying and Managing the Site, 10 – Special Management Situations, 11 – Preserving Existing Trees, 16 – Tree Hazard Management, 17 – Preventative Maintenance and Repair.
- G. Any proposed pruning of existing plant material to remain on site shall be approved by the Landscape Architect prior to beginning pruning operations. Any proposed pruning of trees or plant material within the City of Madison right-of-way shall be approved by a City Forestry Representative prior to beginning pruning operations.

1.06 COORDINATION

- A. Preinstallation Conference: Conduct conference at Project site. Before tree protection and trimming operations and construction activities begin, meet with the Landscape Architect, Arborist, Tree Service Firm, General Contractor and/or other concerned entities to review tree protection and trimming procedures and responsibilities. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
 - 1. Construction schedule. Verify availability of materials, personnel, and equipment needed to make progress and avoid delays.
 - 2. Enforcing requirements for protection zones.
 - 3. Tree removals and safety procedures related to felling and grinding.

4. Field quality control.
- B. Coordinate tree protection and any additional removals with all other work occurring on site. Tree protection measures shall be in place and secured prior to any of the other project site clearing, demolition, grading, or construction (pavements, curb and gutter, fill placement, etc.) and measures shall remain intact for the duration of construction, only being removed during final landscape restoration of the site or temporarily to maintain areas within tree protection zones (weeding, watering, mowing, etc.).
- C. Coordinate the work to cause no delays in the overall project schedule, the work of others, or the occupancy of the project.

1.07 PERMITTING

- A. Tree Removals Permit: The project does not currently anticipate any tree removals in the right-of-way, however, if unanticipated tree removals in the right-of-way are required, they will require a Street Tree Removals Permit. Contact City of Madison Forestry Representative at 608-266-4816 to obtain the permit and to conduct a separate pre-removal conference with a City Forestry Representative on site to review the tree location and requirements related to removing a City tree at least one week prior to the intended removal. The Contractor is fully responsible for initiating this coordination in keeping with the overall project schedule, for preparing the paperwork associated with the permit, for paying any and all fees associated with the permit, and for being present at the meeting with City Forestry Representative(s).
- B. General Prime Contractor may be required to obtain a Street Terrace and Street Occupancy Permit from the City of Madison for tree removals based on the nature of the work and specific access requirements. If required, the Contractor is fully responsible for initiating this coordination in keeping with the overall project schedule, for preparing the paperwork associated with the permit, for paying any and all fees associated with the permit, and for being present at the meeting with City Representative(s), as required.

1.08 PROJECT CONDITIONS

- A. The following practices are prohibited within tree protection zones:
 1. Storage of construction materials, debris, or excavated material.
 2. Parking vehicles or equipment.
 3. Foot traffic.
 4. Erection of sheds or structures.
 5. Impoundment of water or excessive wetting.
 6. Spillage of noxious material while mixing, placing or storing construction materials.
 7. Excavation or other digging unless otherwise indicated.
 8. Compaction of soil over root systems.
 9. Fill more than one inch over tree roots.
 10. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- B. Do not direct vehicle or equipment exhaust toward tree protection zones.
- C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 PRODUCTS

2.01 TOPSOIL

- A. Topsoil shall conform to the testing requirements and standards outlined in Section 32 91 13 "Soil Preparation" to be used on the project.
- B. Shredded hardwood bark mulch, free of deleterious materials and conforming to the specifications outlined in Section 32 93 00 "Plants", shall be provided as indicated in the plans or required by the Landscape Architect or City of Madison Forestry Representative.

- C. Chipped material from tree removal operations may NOT be used as organic mulch for any portion of the project.

2.02 TREE PROTECTION ZONE FENCING AND SIGNAGE

- A. Tree Protection Fencing and Signage in the Terrace (Right-of-way): Refer to City of Madison Standard Specifications, Section 107.13 and conform tree protection materials and work within the City right-of-way to the City's Tree Protection Specification found at: <https://www.cityofmadison.com/business/pw/specs.cfm> and/or the project documents, whichever requires the more stringent measures as determined by the Landscape Architect or City of Madison Forestry Representative.
- B. Tree Protection Fencing and Signage within the Project Boundary:
 - 1. Fence: Provide Galvanized-steel 6-foot height chain-link fencing, fixed in position, fabricated from minimum 2-inch opening, 0.148-inch diameter wire chain link fabric; with pipe posts, minimum 1.9-inch OD posts, with 1-5/8-inch OD top rails and 0.177-inch diameter bottom tension wire pr 1-5/8" bottom rails and any other accessories for a complete fence system
 - 2. Fence Footings: Temporary barrier base footings, 24" x 24" x 7" with stubs for post sleeving and used to receive the posts of temporary chain link fence, allowing the connection of two panels to the same footing. Contractor may also utilize single post temporary barrier bases depending on project requirements for size and shape of tree protection zones.
 - 3. Footing Support: Provide Sandbags or other weighted means of supporting the temporary barrier base footings in an adequate weight and number at each post base so as to safely and securely construct and maintain tree protection fencing in upright, stable position for the duration of the tree protection zone requirements.
 - 4. Signage: Provide shop fabricated, rigid plastic or metal sheet with attachment holes pre-punched and reinforced; legibly printed with nonfading lettering and as follows:
 - a. Size and Text: Tree Protection Zone – Do Not Enter
 - b. Lettering: 3-inch-high minimum, white characters on red background.
 - c. Provide a minimum of four (4) signs per tree protection zone, one facing in each direction.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion and sedimentation control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree protection zones.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 2. Report any damage to adjacent surfaces. Do not proceed with installation until all unsatisfactory or damaged adjacent conditions have been documented and corrected.
- B. To minimize erosion, limit heavy equipment travel only to areas that are necessary to complete the work.

3.02 TREE AND PLANT PROTECTION ZONES

- A. Take steps to prevent damage to existing tree root systems, trunks, and branches of trees to be protected on the project site and/or within City right-of-way that are proximate to the work on this site. Install protection fencing along edges of vegetation zones in accordance with this Section, the working drawings, and to prevent unnecessary or accidental damage or removals to vegetation, including the canopy of large trees with trunks located off the site but with canopies that overhang the project site.
- B. Existing trees within this project site that are to be preserved shall be pruned, watered, and fertilized by a licensed arborist prior to any site clearing, tree removal, or other construction activities.
- C. Prior to any construction set-up, staging, or other construction activity, trees to be protected are to be fenced and Contractor shall request review and approval of all fencing locations and extents by the Landscape Architect and City of Madison Forestry Representative before proceeding with any work.

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- D. Right-of-Way Tree Protection: Contractor shall install tree protection fencing in accordance with Section 107.13 of the City of Madison Standard Specifications for Public Works Construction. Install fencing the area between the curb and sidewalk and extend it at least 5 feet from both sides of the tree along the length of the terrace at a minimum and preferably to the outside edges of tree canopy, whichever is greater. No excavation is permitted within 5 feet of the outside edge of a tree trunk. If excavation within 5 feet of any tree is necessary, contractor shall contact City Forestry Representative at 608-266-4816 prior to excavation to assess the impact to the tree and root system.
 - E. Do not prune right-of-way trees. If pre-construction right-of-way tree pruning is required for construction clearances or other means and/or if a right-of-way tree is damaged at any time, requiring pruning to remove damaged limbs, the Contractor shall immediately contact City Forestry and the pruning work will be performed by City Forestry crews unless otherwise directed by the City Forester supervisor for the project's precinct location.
 - F. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
 - G. Carefully strip existing lawn (if applicable) and apply 2-inch average thickness of organic mulch in a 4-foot diameter mulch ring around base of all trees in lawn areas to be protected, or other size and shape configuration if directed by a Project Representative. Do not place mulch within 6-inches of tree trunks.
 - H. Install protection zone fencing along edges of protection zones in a manner that will prevent people or vehicles from easily entering protected area. Install fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or near temporary or permanent intersections, drives, or other vehicular circulation. Install fence in a manner that does not damage tree roots. Install fence in a manner that is safe, secure and stable.
 - I. Tree Protection Zones include the canopy area above and beyond all tree protection areas as indicated in the drawings. Canopy damage to protected vegetation is not acceptable. Contractor shall take extraordinary measures to protect tree canopies and trunks from aerial construction equipment and shall maintain an aerial clear zone over the trees and other vegetation for the extent of the entire tree protection area and beyond to the edge of each individual tree canopy.
 - J. Tree protection zone fencing shall be erected before any construction activities commence and remain until construction has concluded and shall be installed and removed without harm to trees. If trees scheduled to remain are injured notify the Landscape Architect immediately; if injured trees are within the City right-of-way, notify the Landscape Architect and City Forestry representative(s) immediately.
 - K. Fencing within Project Boundary: Install in accordance with manufacturer's written instructions. Fencing shall circumnavigate the entire tree protection zone, overlapping a minimum of one panel (a panel being the space between posts) at the ends.
 - L. Posts within Project Boundary: Set posts in position and provide weighted, post plate footings so as not to disturb the soil surface. Provide posts at a maximum spacing of 6'-0" on-center.
 - 1. Alternative fence support not designated in project documents requires written approval by the Landscape Architect prior to installation on the project.
 - M. Tree Protection Zone Signage within Project Boundary: Install protection zone signage in visible prominent locations in a manner approved by the Landscape Architect. Install one sign spaced approximately every 20 feet on tree protection fencing, but no fewer than four signs each facing a different direction for circular or rectangular tree protection zones.
 - N. Conform all of the work in the right-of-way to City of Madison Standard Specifications for Public Works construction, Section 107.13.
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- O. Contractors will be responsible for setting up tree maintenance programs to maintain all trees and surfaces within construction boundaries, including City terrace areas, for the duration of construction and until tree protection measures are completely removed from the site. The Contractor shall perform weekly inspections and maintenance of tree protection areas during the growing season (March 1 through November 30). The following maintenance items are considered minimums in addition to maintaining the protection fence and signage at all times:
 - 1. Mowing to maintain lawn areas in an acceptable condition; hand-mow when grass length exceeds 5-inches and cut to no shorter than 2.5-inches at any single mowing.
 - 2. Trash removal.
 - 3. Fall leaf removal.
 - 4. Snow removal, only as necessary to maintain tree protection measures; snow that falls within tree protection areas may be left in-place unless it causes negative impacts to the vegetation or surrounding surfaces or construction areas. Additional snow from snow removal operations may not be directed or dumped into tree protection areas for storage.
 - 5. Supplemental watering for existing trees to be protected.
 - 6. Refreshing shredded hardwood bark mulch rings at the end of the construction period when tree protection measures are removed.
 - P. Repair trees, shrubs, and other vegetation that are damaged by construction operations. Repair should occur within 24 hours of the damage. Treat damaged trunks, limbs, and roots according to a certified arborist's written instructions and Landscape Architect's approval.
 - Q. Maintain tree protection zone fencing and signage in good condition as acceptable to the Landscape Architect and/or City of Madison Representatives and remove when construction operations are complete, and equipment has been removed from the site.
 - R. Do not remove tree protection fencing, even temporarily, to allow for deliveries or equipment access through the protection zone.
 - S. Temporary access will only be allowed to provide hand-maintenance (hand-mowing, weeding, trash removal, leaf removals, etc.) activities to occur throughout the duration of construction. After regular maintenance activities occur, immediately replace and re-secure fencing.
 - T. Temporary access for non-maintenance items may be permitted subject to preapproval in writing by Landscape Architect and/or City of Madison Representative if a root buffer effective against soil compaction is constructed. Maintain root buffer so long as access is permitted; canopies must still be protected during temporary access.
 - U. Do not store construction materials, debris, or excavated material inside tree protection zones.
 - V. Roots torn or damaged by construction operations shall be repaired according to the standards outlined in this section and by a certified arborist.
 - W. Silt fence may not be trenched within the Tree Protection Zone of any tree. In areas where silt fence is installed within Tree Protection Areas, silt fence shall be folded toward the flow direction and secured at grade-level by pinning or backfilling with a 6" layer of clear stone.
 - X. Soil compaction and/or chemical contamination of soil within Tree Protection Zones is unacceptable.

3.03 EXCAVATION AND ROOT PRUNING

- A. Excavate at edge or beyond tree protection zones whenever possible. Install shoring or other protective support systems to minimize sloping or benching of excavations.
- B. Trenching near trees: Where utility trenches are required within tree protection zones, tunnel under the roots a minimum of 24" below the soil surface by drilling, auger boring, pipe jacking or digging by hand. Open cut trenches within tree protection zones will require additional review and written sign-off by the Landscape Architect prior to excavation or utility work commencing.

- C. Root pruning at edge of tree protection zone: Prune roots 12 inches outside of the protection zone, by cleanly cutting all roots to the depth of required excavation. Structural roots damaged within the TPZ should be examined by the Consulting Arborist, cut clean and measured if possible. The distance from the trunk to the damaged area should also be measured. The information can be used post construction to determine how much of the root zone was compromised.
- D. Do not cut main lateral tree roots or tap roots; cut only smaller roots and only as required for root pruning. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3-inches back from new construction as required for root pruning.
- E. If root pruning is necessary, a Contractor-retained, certified arborist shall perform all root pruning operations once the roots have been exposed by hand excavation. Do not use a backhoe or other equipment that rips, tears, or pulls roots. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil. Once roots are exposed and supported, cut roots manually with sharp saw or clean pruning instruments to ensure a clean cut; do not break, tear, chop or slant the cuts. Torn or ripped roots must be trimmed.
- F. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with topsoil or planting mixture.
- G. Backfill as soon as possible with topsoil or planting mixture as outlined in Section 32.91.13, "Soil Preparation". Tamp to settle soil and eliminate voids and air pockets. When the area is approximately one-half filled with topsoil, water thoroughly then place the remaining topsoil required to fill around the exposed roots.
- H. Preventing Oak wilt: Do not prune, cut or injure Oaks between April 1 and September 15; this includes oak roots. If an Oak is wounded during this period, cover the wound immediately with tree wound paint (water-based paint). During the low-risk period between September 15 and October 31 covering wound is optional. November through March is the preferred period for pruning and tree removal. Refer to Wisconsin Department of Natural Resources Forestry Division Publication PUB-FR-127 2009 for further Oak tree protection requirements.

3.04 REGRADING

- A. Minor Fill: Where existing grade is 1 inch or less below elevation of finish grade in a tree protection zone, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations. Note: raising grade within a tree protection zone should be minimal in area and depth and can be fatal to trees. No grade change is acceptable over Oak or Elm tree roots.
- B. Grade Lowering: Where new finish grade is indicated below existing grade around trees slope grade away beyond tree protection zones. Maintain existing grades within tree protection zones.

3.05 CROWN PRUNING

- A. Coordinate any pruning of trees and/or repairs to damaged limbs with the Landscape Architect. Pruning shall be performed by a Contractor-retained, certified arborist. If pruning is required in the right-of-way, the Contractor shall contact City Forestry immediately; City Forestry will perform right-of-way pruning with their own crews.
- B. Prune branches that are affected by temporary and permanent construction. Pruning should be the minimum necessary and not more than $\frac{1}{4}$ of the live foliage/branches of a mature tree. Prune branches as follows:
 - 1. Prune trees to remain to compensate for root loss caused by damaging or cutting root system.
 - 2. Prune the minimum amount necessary. Do not remove more than $\frac{1}{4}$ of the live foliage or branches of a mature tree.
 - 3. Pruning standards: Prune trees according to ANSI A300 Pruning Standards.

4. Perform pruning using scissors-style cutting devices, and not anvil-style hand pruners, pole pruners or loppers. Cut branches with sharp pruning instruments; do not chop or break.
5. Preventing Oak wilt: Do not prune, cut or injure Oaks between April 1 and September 15. If an Oak is wounded during this period, cover the wound immediately with tree wound paint (water-based paint). During the low-risk period between September 15 and October 31 covering wound is optional. November through March is the preferred period for pruning and tree removal. Refer to Wisconsin Department of Natural Resources Forestry Division Publication PUB-FR-127 2009 for further Oak tree protection requirements.
6. Evergreens shall only be pruned to remove dead, broken or damaged branches.
7. Dispose of all material removed during pruning or root pruning operations off-site.

3.06 FELLING, REMOVALS AND DISPOSAL OF MATERIAL TO BE REMOVED

- A. To minimize soil compaction, damage from tires, etc., the Contractor shall lay down wood planking as a surface for site and soils protection during tree removal operations.
- B. Protect all adjacent pavements, features, vegetation and other existing site improvements from damage during felling and removal operations. Fell trees to be removed in a manner that prevents damage to adjacent structures and to those trees, shrubs, other plant materials and site improvements designated to remain.
- C. Repair damaged erosion control features immediately.
- D. Properly barricade perimeter around felling operations to protect pedestrian and vehicular safety and to prevent unauthorized access during removal operations.
- E. Notify the Landscape Architect, General Contractor and City of Madison Forestry Representative (if trees are within the City right-of-way) to removals with date, time and location of intended removals.
- F. Remove and dispose of trees, stumps, roots, debris, and other items within the construction limit line(s) as shown on the drawings.
- G. Fell trees to prevent damage to adjacent structures and to those trees designated to remain.
- H. Remove stumps, logs, roots, other organic matter encountered as part of tree removals to the depth indicated:
 1. Walks: 24 inches below final project subgrades
 2. Roads and drives and parking areas: 36 inches below final project subgrades
 3. Concrete slabs: 24 inches below final project subgrades
 4. Lawn areas: 18 inches below final project finished grades
 5. Footings and foundations and/or utility structures: full depth
- I. Grubbing operations must be completed by the Contractor to remove trunk and stump sections by chipping or by grinding. Chipped material must be separated from adjacent soils and removed from the project.
- J. For areas that will be restored as pavements, foundations, or utility structures backfill depressions from clearing and grubbing operations with a clean material consisting of inorganic soil or a mixture of inorganic soil and rock, stone or gravel. The material shall be free of topsoil, sod, stumps, wood, asphalt, concrete, debris, and other deleterious material. The maximum dimension of any material shall not exceed 2' in any direction.
- K. For areas that will be restored as lawns, planting beds or other softscape/landscape area, backfill depressions with native soils up to 12" below finished grades, then provide topsoil or planting soil conforming to Section 32 91 13, "Soil Preparation" for the final grading to match adjacent grades, installing in 8-inch maximum lifts and lightly tamping between each lift to prevent against settling.
- L. Examine backfilled holes regularly for the duration of construction for settling or sinking in areas where a root mass was removed; replenish topsoil as often as necessary to maintain grade equal to adjacent grades.

3.07 REPAIR AND REPLACEMENT

- A. The Contractor will be fully responsible for paying fees or fines to the City of Madison AND for the full cost of providing any replacement trees required by the City for any right-of-way trees damaged beyond repair and/or trees removed without a tree removals permit being obtained.
- B. Repair trees that are damaged by construction operations, in accordance with a certified arborist's written instructions and approved by the Landscape Architect.
- C. Replace vegetation that cannot be repaired and restored to full growth status, as determined by the Landscape Architect at no additional cost to the project. Provide new trees of same size and species as those being replaced at a minimum 2.5 inches caliper size per ANSI Z.60.1.
- D. The value of trees destroyed or damaged will be charged against the account of the contractor responsible for the damage in an amount determined by the City's certified arborist using the ISA-International Society of Arboriculture, Council of Tree & Landscape Appraiser's Guide for Plant Appraisal, Current Edition. If a replacement tree is provided, the amount charged against the contractor will be reduced by the value of the replacement tree.
- E. Remove and replace trees indicated to remain that die or are damaged during construction operations that a certified arborist determines are incapable of restoring to normal growth pattern and approved by the Landscape Architect at no additional cost to the project.
- F. Plant and maintain replacement plant material as specified in Section 32 93 00, "Plants", and/or per City of Madison directives.
- G. Soil Aeration: Aerate surface soil compacted during construction in any existing lawn areas with tree protection zones that will remain as part of the final landscape restoration. Aerate compacted lawn areas taking care not to hit roots of the trees. Drill 2-inch-diameter holes a minimum of 3-inches deep at approximately 3-inches on center. Backfill holes with an equal mix of augured soil and sand.

3.08 MAINTENANCE OF PROTECTED PLANT MATERIAL

- A. Existing plant material (including, but not limited to, trees and lawn areas within tree protection zones) that is protected during construction shall be maintained during and after construction according by weeding, watering, fertilizing and otherwise caring for the protected plant material. Existing plant material that is protected shall be held to the same standards, requirements, replacements and maintenance period as new planted plant material.
- B. Replacements for damaged plant material may be required based on the extent and severity of damage. However, all plant material indicated to remain will be monitored for the duration of the maintenance period and any additional protected plant material that shows no immediate damage or injury but declines rapidly because of construction operations or negligence or maintenance neglect over the course of the maintenance period will be required to be replaced or charged against the account of the contractor responsible for the damage.

3.09 DISPOSAL OF SURPLUS AND WASTE MATERIAL

- A. All removed tree material, including roots and trimmed branches, chipped material and other debris shall be removed from the site by the Contractor at the end of each workday and legally disposed of off the City's property. Chipping material and re-spreading it on site is not permitted. Burning of surplus waste material is not permitted.
- B. Clearing and grubbing debris shall be disposed of at facilities designed to accept the material that is being disposed. Follow all local, state and federal regulations.
- C. All tree protection and erosion control measures shall be removed completely from the site by the Contractor at the end of construction and just prior to final landscape restoration.

END OF SECTION

**SECTION 31 22 00
GRADING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Removal of topsoil.
- B. Rough grading the site for site structures.
- C. Finish grading.

1.02 RELATED REQUIREMENTS

- A. Section 31 02 00 - General Requirements for Sitework
- B. Section 31 10 00 - Site Clearing.
- C. Section 31 13 00: Selective Tree Protection and Removal
- D. Section 31 23 16.13 - Trenching: Trenching and backfilling for utilities.
- E. Section 31 23 23 - Fill: Filling and compaction.
- F. Section 32 91 13: Soil Preparation

1.03 SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Topsoil: See Section 32 91 13: Soil Preparation

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.
- B. Verify the absence of standing or ponding water.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Stake and flag locations of known utilities.
- C. Locate, identify, and protect from damage above- and below-grade utilities to remain.
- D. Notify utility company to remove and relocate utilities.
- E. Provide temporary means and methods to remove all standing or ponding water from areas prior to grading.
- F. Protect site features to remain, including but not limited to bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs, from damage by grading equipment and vehicular traffic.
- G. Protect trees to remain according to section 31 13 00 Selective Tree Protection and Removal.
- H. Protect plants, lawns, rock outcroppings, and other features to remain as a portion of final landscaping.

3.03 ROUGH GRADING

- A. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.
- B. Do not remove topsoil when wet.

- C. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.
- D. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.
- E. When excavating through roots, perform work by hand and cut roots with sharp axe.
- F. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.
- G. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack surface water control.

3.04 SOIL REMOVAL

- A. Stockpiles: See section 32 91 13 Soil Preparation

3.05 FINISH GRADING

- A. Before Finish Grading:
 - 1. Verify building and trench backfilling have been inspected.
 - 2. Verify subgrade has been contoured and compacted.
- B. Remove debris, roots, branches, stones, in excess of 1/2 inch in size. Remove soil contaminated with petroleum products.
- C. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 3 inches.
- D. Place topsoil where required to level finish grade.
- E. Place topsoil to thickness as indicated in section 32 91 13 – Soil Preparation.
- F. Place topsoil during dry weather.
- G. Remove roots, weeds, rocks, and foreign material while spreading.
- H. Near plants spread topsoil manually to prevent damage.
- I. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.
- J. Lightly compact placed topsoil.
- K. Maintain stability of topsoil during inclement weather. Replace topsoil in areas where surface water has eroded thickness below specifications.

3.06 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 0.10 foot (1-3/16 inches) from required elevation.
- B. Top Surface of Finish Grade: Plus or minus 0.04 foot (1/2 inch).

3.07 REPAIR AND RESTORATION

- A. Existing Facilities, Utilities, and Site Features to Remain: If damaged due to this work, repair or replace to original condition.
- B. Other Existing Vegetation to Remain: If damaged due to this work, replace with vegetation of equivalent species and size.

3.08 FIELD QUALITY CONTROL

- A. See Section 31 23 23 for compaction density testing.

3.09 CLEANING

- A. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water.
- B. Leave site clean and raked, ready to receive landscaping.

END OF SECTION

**SECTION 31 23 16
EXCAVATION****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Excavating for building volume below grade, footings, pile caps, slabs-on-grade, paving, site structures, and utilities within the building.
- B. Trenching for utilities outside the building to utility main connections.
- C. Temporary excavation support and protection systems.

1.02 RELATED REQUIREMENTS

- A. Section 01 57 13 - Temporary Erosion and Sediment Control: Slope protection and erosion control.
- B. Section 01 77 00 - Closeout Procedures: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring. General requirements for dewatering of excavations and water control.
- C. Section 21 05 53 - Identification for Fire Suppression Piping and Equipment: Underground warning tapes at underground fire suppression lines.
- D. Section 22 05 53 - Identification for Plumbing Piping and Equipment: Underground warning tapes at underground plumbing lines.
- E. Section 23 05 53 - Identification for HVAC Piping and Equipment: Underground warning tapes at underground HVAC lines.
- F. Section 26 05 53 - Identification for Electrical Systems: Underground warning tapes at underground electrical lines.
- G. Section 31 10 00 - Site Clearing: Vegetation and existing debris removal.
- H. Section 31 22 00 - Grading: Grading.
- I. Section 31 23 16.13 - Trenching: Excavating for utility trenches outside the building to utility main connections.
- J. Section 31 23 23 - Fill: Fill materials, backfilling, and compacting.
- K. Section 32 00 00 - General Requirements for Sitework

1.03 REFERENCE STANDARDS

- A. Standard Specifications for Public Works Construction, latest edition
 - 1. <https://www.cityofmadison.com/engineering/developers-contractors/standard-specifications>
- B. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Temporary Support and Excavation Protection Plan.
- C. Project Record Documents: Record drawings at project closeout according to 01 78 39 - As-Built Drawings and Section 01 77 00 - Closeout Procedures. Show locations of installed support materials left in place, including referenced locations and depths, on drawings.
- D. Shoring Installer's Qualification Statement.
- E. Field Quality Control Submittals: Document visual inspection of load-bearing excavated surfaces.

1.05 QUALITY ASSURANCE

- A. Temporary Support and Excavation Protection Plan:
 - 1. Indicate sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property.

2. Include drawings and calculations for bracing and shoring.
- B. Designer Qualifications: For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- C. Shoring Installer Qualifications: Company specializing in performing the shoring and bracing work of this section with minimum 5 years of documented experience.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Bedding and Fill to Correct Over-Excavation:
 1. See Section 31 23 23 for bedding and corrective fill materials at general excavations.
- B. Underground Warning Tapes:
 1. See Section 21 05 53 for underground warning tapes at underground fire suppression lines.
 2. See Section 22 05 53 for underground warning tapes at underground plumbing lines.
 3. See Section 23 05 53 for underground warning tapes at underground HVAC lines.
 4. See Section 26 05 53 for underground warning tapes at underground electrical lines.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the work are as indicated.
- B. Survey existing adjacent structures and improvements and establish exact elevations at fixed points to act as benchmarks.
 1. Resurvey benchmarks during installation of excavation support and protection systems and notify Owner if any changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.
- C. Determine the prevailing groundwater level prior to excavation. If the proposed excavation extends less than 1 foot (305 mm) into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by Architect. If the proposed excavation extends more than 1 foot (305 mm) into the prevailing groundwater, control groundwater intrusion with a comprehensive dewatering procedures, or as directed by Geotechnical Engineer.
 1. Perform dewatering in accordance with Standard Specifications for Public Works Construction, latest edition, Part V, Article 502.1

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. See Section 31 10 00 for clearing, grubbing, and removal of existing debris.
- C. See Section 31 22 00 for topsoil removal.
- D. Locate, identify, and protect utilities that remain and protect from damage.
- E. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- F. Protect plants, lawns, rock outcroppings, and other features to remain.
- G. Grade top perimeter of excavation to prevent surface water from draining into excavation. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by Architect.

3.03 TEMPORARY EXCAVATION SUPPORT AND PROTECTION

- A. Excavation Safety: Comply with OSHA's Excavation Standard, 29 CFR 1926, Subpart P.
 1. Excavations in stable rock or in less than 5 feet (1.5 m) in depth in ground judged as having no cave-in potential do not require excavation support and protection systems.

2. Depending upon excavation depth, time that excavation is open, soil classification, configuration and slope of excavation sidewalls, design and provide an excavation support and protection system that meets the requirements of 29 CFR 1926, Subpart P:
 - a. Sloping and benching systems.
 - b. Support systems, shield systems, and other protective systems.
- B. Leave excavation support and protection systems, used as formwork or within 10 feet (3.03 m) of existing foundations, permanently in place, unless otherwise noted.
 1. Cut off top 4 feet (1.22 m) below grade, abandon remainder.
- C. Excavation support and protection systems not required to remain in place may be removed subject to approval of Owner or Owner's Representative.
 1. Remove temporary shoring and bracing in a manner to avoid harmful disturbance to underlying soils and damage to buildings, structures, pavements, facilities and utilities.

3.04 EXCAVATING

- A. Excavate to accommodate new structures and construction operations.
 1. Excavate to the specified elevations.
 2. Excavate to the length and width required to safely install, adjust, and remove any forms, bracing, or supports necessary for the installation of the work.
 3. Cut utility trenches wide enough to allow inspection of installed utilities.
 4. Hand trim excavations. Remove loose matter.
- B. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- C. Preparation for Piling Work: Excavate to working elevations. Coordinate special requirements for piling.
- D. Do not interfere with 45 degree bearing splay of foundations.
- E. Provide temporary means and methods, as required, to remove all water from excavations until directed by Architect. Remove and replace soils deemed suitable by classification and which are excessively moist due to lack of dewatering or surface water control.

3.05 SUBGRADE PREPARATION

- A. See Section 31 23 23 for subgrade preparation at general excavations.

3.06 FILLING AND BACKFILLING

- A. Do not fill or backfill until all debris, water, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from excavation.
- B. Install underground warning tape at buried utilities according to Sections 21 05 53, 22 05 53, 23 05 53, and 26 05 53.
- C. See Section 31 23 23 for fill, backfill, and compaction requirements at general excavations.
- D. See Section 31 22 00 for rough and final grading and topsoil replacement requirements.

3.07 REPAIR

- A. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 31 23 23.

3.08 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.
- B. Provide for visual inspection of load-bearing excavated surfaces by Architect before placement of foundations.

3.09 CLEANING

- A. Stockpile excavated material to be re-used in area designated on site in accordance with Section 31 22 00.
- B. Remove excavated material that is unsuitable for re-use from site.
- C. Remove excess excavated material from site.

3.10 PROTECTION

- A. Divert surface flow from rains or water discharges from the excavation.
- B. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.
- C. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in satisfactory, undisturbed condition.
- D. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- E. Keep excavations free of standing water and completely free of water during concrete placement.

END OF SECTION

SECTION 31 23 16.13 TRENCHING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Backfilling and compacting for utilities outside the building to utility main connections.

1.02 RELATED REQUIREMENTS

- A. Geotechnical report; bore hole locations and findings of subsurface materials.
- B. Section 03 30 00 - Cast-in-Place Concrete.
- C. Section 31 22 00 - Grading: Site grading.
- D. Section 32 00 00 - General Requirements for Sitework

1.03 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.
- B. Subgrade Elevations: 4 inches below finish grade elevations indicated on drawings, unless otherwise indicated.

1.04 REFERENCE STANDARDS

- A. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop 2022, with Errata .
- B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)) 2012 (Reapproved 2021).
- C. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)) 2012 (Reapproved 2021).
- D. Standard Specifications for Public Works Construction, latest edition, Part V, Article 502
 - 1. <https://www.cityofmadison.com/engineering/developers-contractors/standard-specifications>

1.05 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. See Section 31 02 00 - General Requirements for Sitework, for submittal procedures
- C. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- D. Compaction Density Test Reports.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.
- B. When fill materials need to be stored on site, locate stockpiles where indicated.
 - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 - 2. Prevent contamination.
 - 3. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS

2.01 FILL MATERIALS

- A. Soil Fill: Comply with the type indicated on the Drawings.
- B. Structural Fill: See 32 23 23.
- C. Granular Fill: Comply with type indicated on the Drawings.
- D. Pea Gravel: Comply with the type indicated on the Drawings.
- E. Sand Fill: Comply with the type indicated on the Drawings.

2.02 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for testing and analysis of soil material.
- B. See Section 31 02 00 - General Requirements for Sitework, for general requirements for testing and analysis of soil material.
- C. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.
- D. If tests indicate materials do not meet specified requirements, change material and retest.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that survey bench marks and intended elevations for the work are as indicated.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- C. Protect plants, lawns, rock outcroppings, and other features to remain.
- D. Grade top perimeter of trenching area to prevent surface water from draining into trench. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by the Architect.

3.03 TRENCHING

- A. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- B. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- C. Do not interfere with 45 degree bearing splay of foundations.
- D. Cut trenches wide enough to allow inspection of installed utilities.
- E. Hand trim excavations. Remove loose matter.
- F. Remove excavated material that is unsuitable for re-use from site.
- G. Remove excess excavated material from site.
- H. Provide temporary means and methods, as required, to remove all water from trenching until directed by the Architect. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.
- I. Determine the prevailing groundwater level prior to trenching. If the proposed trench extends less than 1 foot into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by the Architect.

3.04 PREPARATION FOR UTILITY PLACEMENT

- A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.
- B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

3.05 BACKFILLING

- A. Backfill for utilities following Standard Specifications for Public Works Construction, Part V Article 502.1 (e)
 - B. Backfill to contours and elevations indicated using unfrozen materials.
 - C. Employ a placement method that does not disturb or damage other work.
-

- D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- E. Backfilled trenches shall be left to the level of the adjacent area or slightly below until restored to reduce the potential for erosion.
- F. Maintain optimum moisture content of fill materials to attain required compaction density.
- G. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- H. Correct areas that are over-excavated.
 - 1. Other areas: Use general fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.
- I. Compaction Density Unless Otherwise Specified or Indicated:
 - 1. Under paving, slabs-on-grade, and similar construction: 97 percent of maximum dry density.
- J. Reshape and re-compact fills subjected to vehicular traffic.

3.06 BEDDING AND FILL AT SPECIFIC LOCATIONS

- A. Use general fill unless otherwise specified or indicated.

3.07 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.
- B. See Section 31 02 00 - General Requirements for Sitework, for general requirements for field inspection and testing.
- C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D1557 ("modified Proctor"), AASHTO T 180, or ASTM D698 ("standard Proctor").
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.

3.08 CLEANING

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION

SECTION 31 23 23
FILL**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Filling, backfilling, and compacting for building volume below grade.
- B. Backfilling and compacting for utilities outside the building to utility main connections.
- C. Filling holes, pits, and excavations generated as a result of removal (demolition) operations.
- D. Lightweight concrete fill.

1.02 RELATED REQUIREMENTS

- A. Document Geotechnical Exploration Report - CGC, Inc.: Geotechnical report; bore hole locations and findings of subsurface materials, dated December 17, 2019.
- B. Section 03 30 00 - Cast-in-Place Concrete.
- C. Section 31 02 00 - General Requirements for Sitework

1.03 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.
- B. Subgrade Elevations: Indicated on drawings.

1.04 REFERENCE STANDARDS

- A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base, and Surface Courses 2017 (Reapproved 2021).
- B. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop 2022, with Errata .
- C. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates 2019.
- D. ASTM C150/C150M - Standard Specification for Portland Cement 2022.
- E. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete 2018.
- F. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)) 2012 (Reapproved 2021).
- G. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method 2015, with Editorial Revision (2016).
- H. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)) 2012 (Reapproved 2021).
- I. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method 2015.
- J. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) 2017, with Editorial Revision (2020).
- K. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils 2017, with Editorial Revision (2018).
- L. ASTM D6817/D6817M - Standard Specification for Rigid Cellular Polystyrene Geofoam 2017 (Reapproved 2021).
- M. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth) 2023.
- N. City of Madison Standard Specifications for Public Works Construction, latest edition
 - 1. <https://www.cityofmadison.com/engineering/developers-contractors/standard-specifications>

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Materials Sources: Submit name of imported materials source.
- C. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used, including manufactured fill.
- D. Compaction Density Test Reports.
- E. Lightweight Concrete Test Reports.

1.06 QUALITY ASSURANCE

- A. Designer Qualifications: Perform design of structural fill under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.
- B. When fill materials need to be stored on site, locate stockpiles where indicated.
 - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 - 2. Prevent contamination.
 - 3. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS**2.01 FILL MATERIALS**

- A. General Fill - Fill Type WISDOT 3/4 inch Gradation: Complying with State of Wisconsin Highway Department standard.
- B. General/Recycled Fill: Comply with City of Madison Standard Specifications for Public Works Construction Part II Article 202 Fill
- C. General Fill - Fill Type S1: Subsoil excavated on-site.
 - 1. Graded.
 - 2. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
 - 3. Complying with ASTM D2487 Group Symbol CL.
- D. Structural Fill - Fill Type WISDOT 1 1/4 inch Gradation: Complying with State of Wisconsin Highway Department standard.
- E. Granular Fill - Fill Type WISDOT Open-Graded Gradation: Coarse aggregate, complying with State of Wisconsin Highway Department standard.
- F. Granular Fill - Gravel - Fill Type A6: Pit run washed stone; free of shale, clay, friable material and debris.
 - 1. Graded in accordance with ASTM C136/C136M, within the following limits:
 - a. 1/2 inch sieve: 100 percent passing.
 - b. 3/8 inch sieve: 85 to 100 percent passing.
 - c. No. 4 sieve: 10 to 30 percent passing.
 - d. No. 8 sieve: 0 to 10 percent passing.
 - e. No. 16: 0 to 5 percent passing.
- G. Granular Fill - Fill Type A7 - 3/4 inch Stone Chips: Crushed stone; free of clay, shale, organic matter.
 - 1. Graded in accordance with the following limits:
 - a. 1 inch: 100 percent passing.
 - b. 3/4 inch: 90 to 100 percent passing.

- c. 3/8 inch: 20 to 55 percent passing.
 - d. No. 4: 0 to 10 percent passing.
 - e. No. 8: 0 to 5 percent passing.
- H. Sand - Comply with City of Madison Standard Specifications for Public Works Construction Part II Section 202, Fill
- I. Bedding of Sewer Pipes - Comply with Standard Specifications for Public Works Construction, Part V Article 502.1
 - 1.
- J. Topsoil - Fill See section 32 91 13
- K. Engineered Fill - Lightweight Concrete:
 - 1. Materials:
 - a. Cement: ASTM C150/C150M.
 - b. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.
 - c. Expansion Material: Manufacturer's recommended expansion material.
 - d. Mix Design: By manufacturer.

2.02 ACCESSORIES

- A. Geotextile: Non-biodegradable, woven.
- B. Vapor Retarder: 15 mil thick, polyethylene.
- C. Geosynthetic Erosion Control: Plastic rings overlaid on grids, interlocking, nonwoven geotextile bottom.
 - 1. Ring Thickness: 1 inch, minimum.
 - 2. Grid Opening: 3 inches (76.2 mm), maximum.
 - 3. Recycled Content: 100 percent.
 - 4. Material: High density polyethylene, minimum 1-1/2 percent carbon black, when tested in accordance with ASTM D1603.
 - 5. Tensile Strength at 2 percent Strain: 400 lb/ft (5.8 kN/m), minimum when tested in accordance with ASTM D6637/D6637M.
 - 6. Ultraviolet Stability: 65 percent, minimum, when tested in accordance with ASTM D4355/D4355M.
 - 7. Manufacturers:
 - a. Invisible Structures; Slopetame: www.invisiblestructures.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for testing and analysis of soil material.
- B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Verify areas to be filled are not compromised with surface or ground water.
- C. See Section 31 22 00 for additional requirements.
- D. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.
- E. Verify structural ability of unsupported walls to support imposed loads by the fill.

- F. Verify underground tanks are anchored to their own foundations to avoid flotation after backfilling.
- G. Verify areas to be filled are not compromised with surface or ground water.

3.02 PREPARATION

- A. Scarify and proof roll subgrade surface to a depth of 6 inches to identify soft spots.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.
- C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.03 FILLING

- A. Fill in accordance with City of Madison Standard Specifications for Public Works Construction Part II, Article 202.3 Construction Methods
- B. Fill to contours and elevations indicated using unfrozen materials.
- C. Fill up to subgrade elevations unless otherwise indicated.
- D. Employ a placement method that does not disturb or damage other work.
- E. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- F. Maintain optimum moisture content of fill materials to attain required compaction density.
- G. Granular Fill: Place and compact materials in equal continuous layers not exceeding 6 inches compacted depth.
- H. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches compacted depth.
- I. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- J. Correct areas that are over-excavated.
 - 1. Load-bearing foundation surfaces: Fill with concrete.
 - 2. Other areas: Use general fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.
- K. Compaction Density Unless Otherwise Specified or Indicated:
 - 1. Under paving, slabs-on-grade, and similar construction: 97 percent of maximum dry density.
 - 2. At other locations: 95 percent of maximum dry density.
- L. Reshape and re-compact fills subjected to vehicular traffic.
- M. Maintain temporary means and methods, as required, to remove all water while fill is being placed as required, or until directed by the Architect. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

3.04 ENGINEERED FILL - LIGHTWEIGHT CONCRETE

- A. Install lightweight concrete fill according to manufacturer's written instructions.
- B. Use batching, mixing, and placing equipment approved by the manufacturer.
- C. Prevent segregation of material.
- D. Tolerance: Finished surface within 2 inches of elevation indicated on drawings.

3.05 FILL AT SPECIFIC LOCATIONS

- A. Use general fill unless otherwise specified or indicated.
- B. Structural Fill:
 - 1. Use general fill.
 - 2. Fill up to subgrade elevations.

3. Maximum depth per lift: 6 inches, compacted.
4. Compact to minimum 95 percent of maximum dry density.
- C. Under Interior Slabs-On-Grade:
 1. Use Fill Type WISDOT 3/4 inch Gradation.
 2. Depth: 6 inches deep.
 3. Compact to 95 percent of maximum dry density.
- D. At column Footings:
 1. Use Fill Type: WISDOT 3/4 inch Gradation.
 2. Fill up to subgrade elevation.
 3. Compact each lift to 95 percent of maximum dry density.
- E. At Foundation Walls and Footings:
 1. Use Fill Type WISDOT Open Graded.
 2. Fill up to subgrade elevation.
 3. Compact each lift to 95 percent of maximum dry density.
 4. Do not backfill against unsupported foundation walls.
 5. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.

3.06 TOLERANCES

- A. Top Surface of General Filling: Plus or minus 1 inch from required elevations.
- B. Top Surface of Filling Under Paved Areas: Plus or minus 1 inch from required elevations.

3.07 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.
- B. See Section 31 02 00 - General Requirements for Sitework, for general requirements for field inspection and testing.
- C. Engineered Fill - Lightweight Concrete:
 1. Sampling: During initial placement, take four 3 inch by 6 inch 3 inch by 6 inch test specimens per 303 cubic yards of material placed or for each four hours of placement work.
 2. Testing: Provide third-party testing of samples in accordance with ASTM C796/C796M except do not oven-dry load-test specimens.

3.08 CLEANING

- A. See Section 01 74 19 - Construction Waste Management and Disposal, for additional requirements.
- B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- C. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION

SECTION 32 11 23
AGGREGATE BASE COURSES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aggregate base course.
- B. Paving aggregates.

1.02 RELATED REQUIREMENTS

- A. Section 31 02 00 - General Requirements for Sitework
- B. Section 31 22 00 - Grading: Preparation of site for base course.
- C. Section 31 23 16.13 - Trenching: Compacted fill over utility trenches under base course.
- D. Section 32 12 16 - Asphalt Paving: Finish and binder asphalt courses.
- E. Section 32 13 13 - Concrete Paving: Finish concrete surface course.
- F. Section 32 14 13.13 - Miscellaneous Landscape Surfaces and Stonework
- G. Section 33 05 61 - Concrete Manholes: Manholes including frames.

1.03 REFERENCE STANDARDS

- A. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop 2022, with Errata .
- B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)) 2012 (Reapproved 2021).
- C. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method 2015, with Editorial Revision (2016).
- D. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)) 2012 (Reapproved 2021).
- E. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method 2015.
- F. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) 2017, with Editorial Revision.
- G. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth) 2023.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. See Section 31 02 00 - General Requirements for Sitework, for submittal procedures
- C. Aggregate Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. When aggregate materials need to be stored on site, locate where directed by Owner.
- B. Aggregate Storage, General:
 - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 - 2. Prevent contamination.
 - 3. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Course Aggregate: Comply with types as indicated on the Drawings.
- B. Fine Aggregate: Comply with types as indicated on the Drawings.

2.02 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for general requirements for testing and analysis of aggregate materials.
- B. See Section 31 02 00 - General Requirements for Sitework, for general requirements for testing and analysis of aggregate materials.
- C. Where aggregate materials are specified using ASTM D2487 classification, test and analyze samples for compliance before delivery to site.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that survey bench marks and intended elevations for the work are as indicated.
- B. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.02 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place aggregate on soft, muddy, or frozen surfaces.

3.03 INSTALLATION

- A. Place aggregate in maximum 4 inch layers and roller compact to specified density.
- B. Level and contour surfaces to elevations and gradients indicated.
- C. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
- D. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- E. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for general requirements for field inspection and testing.
- B. See Section 31 02 00 - General Conditions for Sitework, for general requirements for field inspection and testing.
- C. Compaction density testing will be performed on compacted aggregate base course in accordance with ASTM D1556, ASTM D2167, or ASTM D6938.
- D. Results will be evaluated in relation to compaction curve determined by testing uncompacted material in accordance with AASHTO T 180, ASTM D698 ("standard Proctor"), or ASTM D1557 ("modified Proctor").
- E. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- F. Proof roll compacted aggregate at surfaces that will be under slabs-on-grade, pavers, and paving.

3.05 CLEANING

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION

**SECTION 32 12 16
ASPHALT PAVING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Aggregate base course.
- B. Single course bituminous concrete paving.

1.02 RELATED REQUIREMENTS

- A. Section 31 02 00 - General Requirements for Sitework
- B. Section 31 22 00 - Grading: Preparation of site for paving and base.
- C. Section 31 23 23 - Fill: Compacted subgrade for paving.
- D. Section 32 11 23 - Aggregate Base Courses: Aggregate base course.
- E. Section 32 13 13 - Concrete Paving: Concrete substrate.
- F. Section 32 13 13 - Concrete Paving: Concrete curbs.
- G. Section 33 05 61 - Concrete Manholes: Manholes, including frames; gutter drainage grilles, covers, and frames for placement by this section.

1.03 REFERENCE STANDARDS

- A. AI MS-2 - Asphalt Mix Design Methods 2015.
- B. City of Madison Specifications for Public Works Construction, latest edition, Part IV Pavements
 - 1. <https://www.cityofmadison.com/engineering/developers-contractors/standard-specifications>

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Wisconsin Highways standard.
- B. Mixing Plant: Complying with State of Wisconsin Highways standard.
- C. Obtain materials from same source throughout.

1.05 FIELD CONDITIONS

- A. In accordance with City of Madison Standard Specifications for Public Works Construction, Part IV Article 402.2 Placing Asphalt Mixtures

PART 2 PRODUCTS**2.01 REGULATORY REQUIREMENTS**

- A. Comply with applicable code for paving work on public property.

2.02 MATERIALS

- A. Aggregate for Base Course: In accordance with City of Madison Std Specifications Part IV Article 401 CRUSHED AGGREGATE BASE COURSE
- B. Aggregate for Binder Course : Angular crushed washed stone; free of shale, clay, friable material and debris.
- C. Aggregate for Wearing Course: In accordance with State of Wisconsin Highways standards.
- D. Fine Aggregate: In accordance with State of Wisconsin Highways standards.

2.03 ASPHALT PAVING MIXES AND MIX DESIGN

- A. Asphalt Paving Mixes: Comply with types Madison Part IV Pavements, 402 Asphalt Construction

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that compacted subgrade is dry and ready to support paving and imposed loads.
-

- B. Verify gradients and elevations of base are correct.

3.02 BASE COURSE

- A. Place and compact base course.

3.03 PLACING ASPHALT PAVEMENT

- A. Install Work in accordance with State of Wisconsin Highways standards.
- B. Place asphalt in accordance with Part IV Pavements, 402 Asphalt Construction

3.04 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Variation from True Elevation: Within 1/2 inch.

3.05 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for quality control.
- B. See Section 31 02 00 - General Requirements for Sitework, for general requirements for quality control.
- C. Provide field inspection and testing. Take samples and perform tests in accordance with AI MS-2.

3.06 PROTECTION

- A. Immediately after placement, protect pavement from mechanical injury for 1 days or until surface temperature is less than 140 degrees F.

END OF SECTION

SECTION 32 13 13 CONCRETE PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

1.02 RELATED REQUIREMENTS

- A. Section 03 10 00 - Concrete Forming and Accessories.
- B. Section 03 30 00 - Cast-in-Place Concrete.
- C. Section 31 02 00 - General Requirements for Sitework
- D. Section 31 22 00 - Grading: Preparation of site for paving and base and preparation of subsoil at pavement perimeter for planting.
- E. Section 31 23 23 - Fill: Compacted subbase for paving.
- F. Section 32 11 23 - Aggregate Base Courses
- G. Section 32 13 16 - Decorative Concrete Paving
- H. Section 32 12 16 - Asphalt Paving: Asphalt wearing course.
- I. Section 32 14 13.13 - Miscellaneous Landscape Surfaces and Stonework.
- J. Section 32 17 26 - Tactile Warning Surfacing: Plastic tactile and detectable warning tiles for pedestrian walking surfaces.
- K. Section 33 05 61 - Concrete Manholes: Manholes, including frames; gutter drainage grilles, covers, and frames for placement by this section.

1.03 REFERENCE STANDARDS

- A. ACI 211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide 2022.
- B. ACI 301 - Specifications for Concrete Construction 2020.
- C. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete 2000 (Reapproved 2009).
- D. ACI 305R - Guide to Hot Weather Concreting 2020.
- E. ACI 306R - Guide to Cold Weather Concreting 2016.
- F. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2022.
- G. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete 2022.
- H. ASTM C33/C33M - Standard Specification for Concrete Aggregates 2023.
- I. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens 2021.
- J. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete 2023.
- K. ASTM C150/C150M - Standard Specification for Portland Cement 2022.
- L. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method 2023.
- M. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete 2010a (Reapproved 2016).
- N. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete 2019.
- O. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete 2019, with Editorial Revision (2022).

- P. ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete 2023, with Editorial Revision.
- Q. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing 2017.
- R. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types) 2018.
- S. ASTM D1752 - Standard Specification for Preformed Sponge Rubber, Cork, and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction 2018 (Reapproved 2023).
- T. ASTM D8139 - Standard Specification for Semi-Rigid, Closed-Cell Polypropylene Foam, Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction 2017.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. See Section 31 02 00 - General Requirements for Sitework, for submittal procedures.
- C. Product Data: Provide data on joint filler, admixtures, and curing compound.

PART 2 PRODUCTS

2.01 PAVING ASSEMBLIES

2.02 FORM MATERIALS

- A. Form Materials: As specified in Section 03 10 00, comply with ACI 301.
- B. Wood form material, profiled to suit conditions.
- C. Joint Filler: Preformed; non-extruding bituminous type (ASTM D1751) or sponge rubber or cork (ASTM D1752).

2.03 REINFORCEMENT

- A. Reinforcing Steel and Welded Wire Reinforcement: Comply with the Drawings.

2.04 CONCRETE MATERIALS

- A. Obtain cementitious materials from same source throughout.
- B. Concrete Materials: Comply with materials indicated on the Drawings.

2.05 ACCESSORIES

- A. Tactile Warning Surfaces: See Section 32 17 26.

2.06 CONCRETE MIX DESIGN

- A. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.
- B. Concrete Properties:
 - 1. Comply with performance requirements indicated on the Drawings.
- C. See Section 32 13 16 for Decorative Concrete Paving mix requirements

2.07 MIXING

- A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685/C685M. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.
- B. Transit Mixers: Comply with ASTM C94/C94M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

3.02 SUBBASE

- A. See Section 32 11 23 for construction of base course for work of this Section.
- B. Prepare subbase in accordance with State of Wisconsin Highways standards.

3.03 PREPARATION

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Coat surfaces of manhole frames with oil to prevent bond with concrete pavement.
- C. Notify Architect minimum 24 hours prior to commencement of concreting operations.

3.04 FORMING

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.05 REINFORCEMENT

- A. Place reinforcement as indicated.

3.06 COLD AND HOT WEATHER CONCRETING

- A. Follow recommendations of ACI 305R when concreting during hot weather.
- B. Follow recommendations of ACI 306R when concreting during cold weather.
- C. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

3.07 PLACING CONCRETE

- A. Place concrete in accordance with State of Wisconsin Highways standards.
- B. Do not place concrete when base surface is wet.
- C. Ensure reinforcement, inserts, embedded parts, formed joints are not disturbed during concrete placement.
- D. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.

3.08 JOINTS

- A. Align curb, gutter, and sidewalk joints.
- B. Place 3/8 inch wide expansion joints at 20 foot intervals and to separate paving from vertical surfaces and other components and in pattern indicated.
 - 1. Form joints with joint filler extending from bottom of pavement to within 1/2 inch of finished surface.
 - 2. Secure to resist movement by wet concrete.
- C. Provide scored joints.
 - 1. Between sidewalks and curbs.
 - 2. Between curbs and pavement.
- D. Provide keyed joints as indicated.
- E. Saw cut contraction joints 3/16 inch wide at an optimum time after finishing. Cut 1/3 into depth of slab.

3.09 FINISHING

- A. Area Paving: Light broom, texture perpendicular to pavement direction.
 - B. Sidewalk Paving: Light broom, texture perpendicular to direction of travel with troweled and radiused edge 1/4 inch radius.
-

- C. Curbs and Gutters: Light broom, texture parallel to pavement direction.

3.10 TOLERANCES

- A. Maximum Variation of Surface Flatness: 1/4 inch in 10 ft.
- B. Maximum Variation From True Position: 1/4 inch.

3.11 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
 - 1. Provide free access to concrete operations at project site and cooperate with appointed firm.
 - 2. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
 - 3. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.
- B. Compressive Strength Tests: ASTM C39/C39M; for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cu yd or less of each class of concrete placed.
 - 1. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
 - 2. Perform one slump test for each set of test cylinders taken.
- C. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.12 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit pedestrian traffic over pavement for 7 days minimum after finishing.
- C. Do not permit pedestrian traffic over pavement until 75 percent design strength of concrete has been achieved.

END OF SECTION

SECTION 32 13 16
DECORATIVE CONCRETE PAVING

PART 1 GENERAL

1.01 DESCRIPTION

- A. Decorative concrete flatwork paving, including colored concrete and exposed aggregate concrete.

1.02 RELATED REQUIREMENTS

- A. Applicable provisions of Division 01 govern the work under this Section.
- B. Section 31 22 00 - Grading: for excavating and preparing subgrades under decorative concrete paving work.
- C. Section 32 11 23 - Aggregate Base Courses: for aggregates under decorative concrete paving work.
- D. Section 32 13 13 - Concrete Paving: for general requirements related to flatwork concrete pavements.
- E. Section 32 14 13.13 - Miscellaneous Landscape Surfaces: for other landscape-based paving materials and constructions.

1.03 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.04 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
1. Review methods and procedures related to decorative concrete paving, including but not limited to, the following:
 - a. Concrete mixture design.
 - b. Quality control of concrete materials and decorative concrete paving construction practices.
 - c. Finishing concrete materials for exposed aggregate pavements.
 2. Require representatives of each entity directly concerned with decorative concrete paving to attend, including the following: Contractor's superintendent; decorative concrete paving installer.

1.05 ACTION SUBMITTALS

- A. Product Data: For each pre-manufactured or supplied product indicated in this Section.
- B. Samples for Verification:
1. Submit a containerized sample of the aggregate to be used in the exposed aggregate concrete to verify initial color selection.
 2. Submit 6" x 6" pucks or other portable-sized sample of the colored concrete to verify initial color selection.
- C. Mockups: Provide mockups, 2-feet x 2-feet minimum size of each different type of decorative concrete pavement demonstrating the materials, workmanship and other characteristics of the decorative concrete intended for this project. Review mockups with Landscape Architect, City of Madison Representative, and Contractor after concrete has fully cured. Contractor may be required to produce additional mockups if original mockups result in the desire to adjust aggregates, methods of finishing, colored concrete color, etc., and shall do so at no additional cost to the project and with no delays to the project schedule. Approved mockups shall be protected on site or at a nearby location and preserved for the duration of the project such that they become the standard for which the final installed decorative pavements are judged against.

1. Numerous iterations of aggregate color blend+aggregate size blend+ exposure methodologies may be required to produce the desired color, texture and look of the final concrete for the exposed aggregate concrete pavement. This will be an iterative process and the Contractor shall work with the Landscape Architect, Architect and City of Madison Representative at the onset of the project and produce and refine concrete samples until final, desired aggregate color/texture blends are achieved for each different type of decorative concrete.
- D. Design Mixtures: For each decorative concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer, ready-mix concrete manufacturer and testing agency.
- B. Material Certificates: For the following, from manufacturer:
 1. Cementitious materials.
 2. Fiber reinforcement.
 3. Admixtures.
 4. Curing compounds.
 5. Applied finish materials.
 6. Bonding agent or epoxy adhesive.
 7. Joint fillers.
- C. Material Test Reports: For each of the following:
 1. Aggregates. Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
- D. Field quality-control reports.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained in high-quality decorative concrete paving system installation and finishing techniques.
- B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
- C. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.
 1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

1.08 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

1.09 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
 1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 2. Do not use frozen materials or materials containing ice or snow.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- C. Hot-Weather Concrete Placement: Comply with ACI 305.1-14(20) and as follows when hot-weather conditions exist:
 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 PRODUCTS

2.01 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.02 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
 1. Use flexible or uniformly curved forms for curves of a radius of 100 feet or less. Do not use notched and bent forms.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.03 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cementitious Materials:
 1. Portland Cement: ASTM C150/C150M, gray portland cement Type I, Type I/II.
 2. Fly Ash: ASTM C618, Class C or Class F. Do not use fly ash in decorative concrete pavements unless proven not to alter the color saturation through the mock-up process.
 3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
- C. Normal-Weight Aggregates: ASTM C33/C33M, Class 4S, uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.
 1. Maximum Coarse-Aggregate Size: 3/4-inch nominal.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C260/C260M.
- E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain no more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 2. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
 3. Water-Reducing and Accelerating Admixture: ASTM C494/C494M, Type E.
- F. Water: Potable and complying with ASTM C94/C94M.

2.04 DECORATIVE AGGREGATES

- A. Decorative Aggregates: Provide angular, decorative aggregate blend. Aggregate blend will be finalized through the mockup review and approval process.
- B. Obtain each blend of decorative aggregates from a single manufacturer with the resources to provide aggregate blends of a consistent size, color and ratio and consistent quality in appearance and physical properties as the approved samples.
- C. Aggregates for Initial Selections: Provide the following aggregates for initial selections under "Samples for Verification", this section: "Recycled Copper Slag", 1/4" x 1/8" size blend.
 - 1. Aggregates listed is a starting point for decorative concrete pavements. Contractor shall include provisions for changing aggregates and/or adding other aggregates to create a blend and adjusting blends/ratios of aggregates until final desired overall aesthetic for exposed aggregate decorative concrete pavements is achieved through the mockup review and approval process.

2.05 COLORED CONCRETE ADDITIVES

- A. ASTM C979, synthetic mineral-oxide pigments or colored water-reducing admixture; color stable, nonfading, and resistant to lime and other alkalis.
- B. Basis of Design: Integral concrete color, Chromix G (granular) or L (liquid) admixture by Scofield/Sika, or approved equal.
 - 1. Color: French Gray C-14.
- C. Colors listed above is considered a tentative selections. Landscape architect reserves the right to reject color for either colored and/or colored+exposed aggregate decorative concrete pavements and request additional physical samples of manufacturer's standard full range of colors and additional mockups (see mockups, this Section) in order to determine final color selection for both applications.

2.06 FIBER REINFORCEMENT

- A. Synthetic Fiber, Monofilament Fibers: Monofilament polypropylene fibers engineered and designed for use in decorative concrete paving, complying with ASTM C1116/C1116M, Type III, 1/2 to 1-1/2 inches long.

2.07 CURING AND SEALING MATERIALS

- A. Waterborne, Membrane-Forming, Curing Compound: ASTM C309, Type 1, Class B, nondissipating, non-yellowing, manufactured for use with decorative concrete pavements.

2.08 RELATED MATERIALS

- A. Joint Fillers: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D8139, semirigid, closed-cell polypropylene foam in preformed strips.
- B. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.09 CONCRETE MIXTURES

- A. Obtain each type of concrete mixture from single manufacturer with resources to provide concrete of consistent quality in appearance and physical properties.
- B. Provide design mix with a proven track record of work on flatwork applications in Madison, Wisconsin in the past 10-years.
- C. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
- D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions and only if admixtures will not affect the final finish or durability of the concrete pavements.

- E. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb./cu. yd.
- F. Concrete Mixtures: Normal-weight concrete.
 - 1. Compressive Strength (28 Days): 4000 psi.
 - 2. Maximum W/C Ratio at Point of Placement: 0.45.
 - 3. Slump Limit: 4 inches, plus or minus 1 inch.

2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M and ASTM C1116/C1116M. Furnish batch certificates for each batch discharged and used in the Work.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine materials and assemblies for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proceed with concrete installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Remove loose material from subbase surface immediately before placing concrete.
- B. Protect adjacent construction from discoloration and spillage during application of hardeners, release agents, stains, curing compounds, and sealers.

3.03 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.04 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
 - 1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
 - 2. Extend joint fillers full width and depth of joint.
 - 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.

6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated in the Working Drawings. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness.
 1. Sawed Joints for All Promenade Paving: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
 2. Ensure that sawed joints are within 3-inches in any direction of any dowels.

3.05 CONCRETE PLACEMENT

- A. Moisten aggregate subbase for areas to receive concrete provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- B. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- C. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- D. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- E. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating dowels and joint devices.
- F. Screed paving surface with a straightedge and strike off.
- G. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.06 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

3.07 SEEDED AGGREGATE CONCRETE FINISH

- A. After final floating, apply the following finish:
 1. Immediately after floating, broadcast a single layer of aggregate uniformly onto the pavement surfaces as indicated in the Drawings. Tamp seeded aggregate into plastic concrete and float to entirely embed aggregate with mortar cover of 1/16 inch.
 - a. Prior to the concrete placing operation, all select seeding aggregate shall be thoroughly washed so that it is free of all dust, dirt, and clay particles. The aggregate shall be in a damp condition but without free surface water at the time of seeding application. There shall be sufficient select aggregate on hand to complete the seeding once it has commenced.

- b. The seeding operation shall start immediately after the placement of concrete as described above. The select aggregate shall be carefully and uniformly seeded by suitable means so that the entire surface is completely covered with one layer of stone. Stacked stones and flat and slivery particles shall be removed at this time. The aggregate shall be embedded by suitable means. Care shall be taken to not over-embed and deform the surface. Under no circumstances shall areas lacking sufficient mortar be filled with small quantities of the base concrete mix.
- c. Without dislodging aggregate, remove excess mortar by lightly brushing surface with a stiff, nylon bristle broom.
- d. Fine-spray surface with water and brush. Repeat water flushing and brushing cycle until cement film is removed from aggregate surfaces to depth required.
- e. Work shall be planned so that the concrete placing and aggregate seeding procedures are coordinated with the capabilities of the washing and brushing crew.

3.08 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection and ACI 305.1-14(20) for hot weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb./sq. ft. x h and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Compound: Apply immediately after final finishing. Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period. Ensure curing compound does not alter aggregate colors or textures in the finished concrete.

3.09 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117-10 and as follows:
 - 1. Elevation: 3/4 inch.
 - 2. Thickness: Plus 3/8-inch, minus 1/4 inch.
 - 3. Surface: Gap below 10-foot-long, unlevelled straightedge not to exceed 1/2 inch.
 - 4. Lateral Alignment and Spacing of Dowels: 1 inch.
 - 5. Vertical Alignment of Dowels: 1/4 inch.
 - 6. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
 - 7. Joint Spacing: 3 inches.
 - 8. Contraction Joint Depth: Plus 1/4 inch, no minus.
 - 9. Joint Width: Plus 1/8 inch, no minus.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C172/C172M shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain at least one composite sample for each 100-cu. yd. or 5000 sq. ft. (465 sq. m), or fraction thereof of each concrete mixture placed each day, whichever yields the greater testing requirement.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231/C231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31/C31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at seven days and two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Decorative concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

3.11 REPAIR AND PROTECTION

- A. Remove and replace decorative concrete paving that is broken or damaged or does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Detailing: Grind concrete "squeeze" left from tool placement. Remove excess release agent with high-velocity blower.
- C. Protect decorative concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain decorative concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 32 14 13.13
MISCELLANEOUS LANDSCAPE SURFACES

PART 1 GENERAL

1.01 DESCRIPTION

- A. Stabilized aggregate pathways.

1.02 SUMMARY

- A. Applicable provisions of Division 01 shall govern Work of this Section.
- B. Section 01 57 13 "Temporary Erosion and Sediment Control" for erosion materials coordination.
- C. Section 31 22 00 "Grading" for coordination with excavation and subgrade preparation work.
- D. Section 32 33 00 "Site Furnishings" for coordination with other pre-manufactured exterior site furnishing units and installation.
- E. Section 32 13 13 "Concrete Paving" for flatwork concrete pavement surfaces adjacent to landscape surfaces.
- F. Section 32 13 16 "Decorative Concrete Paving" for colored and exposed aggregate concrete pavements.
- G. Section 32 92 19 "Seeding" for coordination with seeded lawns.
- H. Section 32 92 23 "Sodding" for coordination with sodded lawns.
- I. Section 32 93 00 "Plants" for coordination with planting and landscape materials and installations.

1.03 REFERENCES

- A. State of Wisconsin, Department of Transportation, Standard Specifications for Highway and Structures Construction. Current edition.
- B. ASTM C136/C136M – 14. Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- C. ASTM D2419 – 14. Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregates.
- D. ASTM F1951 – 14. Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment.

1.04 SUBMITTALS

- A. Source Data: Provide, prior to ordering or installation, source data for each item listed under PART 2 - PRODUCTS, including company name, product name and any proposed deviations from dimensions, tolerances, materials, or other characteristics. Any deviations are subject to review and approval or rejection. A project representative may cross-check submitted source data with data for materials upon deliver to the project site and prior to installation to ensure that the approved materials are being utilized in the construction of this project.
- B. Samples for Verification: For each of the following:
1. Color photographs of aggregate material to be used. Provide location and contact information for source quarry.
 2. Physical Aggregate Sample: Provide 1-quart bag or equivalent size container of aggregate blend to be used in stabilized aggregate pathway.
- C. Qualification Data: For qualified Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience with stabilized aggregate pathway and surface installations.
- D. Material Certificates/Product Data:
1. For each type of aggregate.
 2. For stabilizing binder material.
 3. For edging materials and accessories for stabilized aggregate pathway, including size/shape and color.

4. Product data for stabilized aggregate, including gradation indicating that it meets the requirements of this section.
5. Stabilized aggregate pathway manufacturer's material safety data sheet.

1.05 QUALITY ASSURANCE

- A. Installer's Qualifications: A qualified Installer whose work with stabilized aggregate pathway and surface installations has resulted in successful design installations and similarly designed landscapes.
 1. Experience: Five years' experience in landscape installation in addition to requirements in Division 01 Section "Quality Requirements."
 2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site at all times when work is in progress. The supervisor shall be the same individual for the duration of the project.
- B. Conduct a Preinstallation Conference at the project site with the Installer's project supervisor, the General Contractor, Landscape Architect and City of Madison Representative present. Review general materials, methods and procedures related to installation including, but not limited to, the following:
 1. Site location and layout of all stabilized aggregate and stone materials.
 2. Construction schedule. Verify ability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 3. Atypical construction: Review project details to clarify any questions related to atypical constructions related to installation.
- C. Do not install stabilized pathway surfacing during rain. Delay installation until forecast does not indicate rain for a full five (5) days after installation. Do not install when temperatures are below 40 deg. F.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Bulk materials shall be stored separately so as not to contaminate or be contaminated by other soils or site construction materials.
- B. Store and handle stone and aggregate materials to prevent deterioration or damage due to contaminants, breaking, chipping, or other causes. Stabilized pathway aggregates must NOT be exposed to moisture prior to installation. If stabilized pathway aggregate becomes exposed to moisture prior to installation, it must be turned to ensure consistent moisture content throughout prior to installation. Verify hydration levels with snowball test before installation. For any additional questions regarding storage, handling or delivery of the stabilized pathway material, contract the manufacturer.
- C. Deliver Organic-Loc stabilizer pre-blended with aggregate whenever possible. Utilize appropriate respirator when dealing with un-blended stabilized pathway materials if ventilation is inadequate. Avoid contact with skin and eyes.

1.07 PROJECT CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, and dimensions of stabilized aggregate pathway construction contiguous with work by field measurements before proceeding with installation work.
- B. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by the City or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:
 1. Notify City of Madison Representative at least two days in advance of proposed interruption of each service or utility.
 2. Do not proceed with interruption of services or utilities without City of Madison Representative's written permission.
- C. Weather Limitations: Proceed with installations only when existing and forecasted weather conditions permit work to be performed when beneficial and optimum results may be obtained.

- D. Contractor shall protect all adjacent plants, lawns, and other surfaces from damage at all times. Damaged plants or surfaces shall be replaced or treated as required to conform to specifications herein for fresh stock.
- E. Work area shall be kept clean and orderly during the installation period. Under no condition shall debris from installation activities result in a safety hazard on-site or to adjacent off-site property. Damage to lawns adjacent construction and/or plantings incurred as a result of installation operations shall be repaired by the Contractor that causes the damage at no cost to the project.

PART 2 PRODUCTS

2.01 STABILIZED AGGREGATE PATHWAY MATERIALS

- A. Stabilized Aggregate Material: Aggregate consisting of sound, angular, durable particles with patented powdered organic binder made from 100% naturally occurring integral binding/stabilizing material, factory blended, specifically for use as a stabilized pathway and surfacing material for exterior applications. Basis of Design: Pathway Aggregate with Organic-Lock Stabilizer by Kafka Granite, or approved equal.
 - 1. Material needs be provided in accordance with ASTM C136:

<u>Sieve</u>	<u>Sieve Size (mm)</u>	<u>Percent Passing</u>
3/8"		100%
4	4.75	80-100%
8	2.36	65-90%
16	1.18	40-65%
30	0.6	25-55%
50	0.3	15-35%
100	0.15	10-20%
200	0.075	5-15%
 - 2. Color: Blend of beige, light brown and cream accents; BOD Color "Golden Cream Marble" by Kafka Granite, or approved equal.
- B. Metal Edging: Standard-profile, commercial-grade, extruded-aluminum edging, ASTM B 221, Alloy 6063-T6, fabricated in standard lengths with interlocking sections with loops stamped from face of sections to receive stakes.
 - 1. Basis of Design: "Asphalt Edge" by Permaloc, or approved equal.
 - 2. Edging Size: L-shaped aluminum edge with 90 deg. corner, 3" x 3". Bottom edge shall have pre-punched holes to receive stakes.
 - 3. Stakes: Aluminum, ASTM B 221, Alloy 6061-T6, 18-inches long, gauge conforming to pre-punched hole size in edging.
 - 4. Finish: Black Duraflex.

2.02 MISCELLANEOUS MATERIALS

- A. Aggregate Leveling Base: Provide open-graded, free-draining, permeable ¾" dense-graded base aggregate per WisDOT State Specifications for Highway Construction (SSHSC), Section 305 where indicated in the Contract Documents.
- B. Soil Materials: Satisfactory soil materials (topsoil, planting mixture, etc.) as defined in Section 32 91 13, "Soil Preparation".

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions, for compliance with requirements for correct and level finished grade, installation tolerances, and other conditions affecting performance. Notify City of Madison Representative and Landscape Architect immediately of any unsatisfactory conditions in writing.

- B. Verify location, type, and elevations of adjacent concrete pavement and verify that all concrete items have fully cured. Verify signage or furnishing base structures, concrete collars around utility structures, drainage inlets, and any other adjacent constructions or other elements within the various landscape paving and surfacing areas to ensure proper setting heights of all adjacent materials and constructions.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Beginning of stabilized aggregate surfacing installation signifies acceptance of edge restraints and any other contiguous constructions that may have been performed by other subcontractors by the installation contractor.

3.02 PREPARATION

- A. Verify that the subgrade soil is free from standing water.
- B. Remove any excess thickness of soil applied over the excavated soil subgrade to trap sediment from adjacent construction activities before placing the materials.
- C. Keep area where surfacing is to be constructed free from sediment during entire job. Remove and replace all materials contaminated with sediment with clean materials.
- D. Prevent damage to inlets and other drainage appurtenances during installation. Report all damage immediately.
- E. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas, planting beds, and existing plants from damage caused by installation operations.
- F. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- G. Contractor shall contact Landscape Architect at least seven (7) working days in advance of installation to coordinate layout.

3.03 INSTALLATION, GENERAL

- A. Contractors and suppliers/manufacturers will be required to work independently and with one another to coordinate with adjacent work, verify all materials, confirm structural integrity of the work, continuously verify field measurements and field construction criteria related thereto, check and coordinated the information contained in submittals and shop drawings, and produce final construction in conformance with the requirements of the contract documents.
- B. The Contractor and all subcontractors will be responsible for continually reviewing and evaluating field conditions and constructions and verifying that grades, dimensions, tolerances and connections between all disciplines and all constructions are in accordance with the drawings and will result in a high-quality project.
- C. Excavate to elevations and dimensions as shown on the Drawings and as necessary to complete construction. Excavations shall be sufficiently deep to provide for all proposed subgrade preparation and base course aggregate.
- D. Cold Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace any and all materials or work damaged by frost or freezing.

3.04 SUBGRADE AND AGGREGATE BASE PREPARATION, METHOD A

- A. Utilize this method for preparing all subgrades and aggregate base course unless otherwise indicated in the drawings.
- B. Hand-tamp only soil subgrade in all areas underneath tree canopies utilizing hand tools.
- C. Identify soft pockets and areas of excess yielding. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting and replace with backfill or fill as directed, hand tamping to provide a stable, uniform subgrade.

- D. Take care to fully hand-compact areas around lamp standards, utility structures, building edges, curbs, tree wells and other protrusions.
- E. Proceed with care around the perimeters of excavations, buildings, curbs, etc. These areas are especially prone to consolidation and settlement. Do not place wedges of backfill in these areas. If possible, particularly in these areas, proceed with backfilling and compacting in shallow lifts, parallel to the finished surface.
- F. Leveling Base: Provide the Base Aggregate material in uniform lifts not exceeding 6 in. over the hand-compact subgrades and hand-compact to depths as indicated. Do not place fill on areas consisting of organic soil, debris, or other soft and yielding material. Do not place fill on frozen or muddy areas. Place, spread, and compact in uniform lifts for full width and length of stabilized aggregate surfacing areas. Place Leveling Base Aggregate, ensuring that moisture content remains constant and density is loose and constant until leveling and compaction.
- G. Hand-compact the Leveling Base Aggregate material with at least four until there is no visible movement. Do not use mechanical tampers or rollers for any areas under tree canopies.
- H. Tolerance: Do not exceed the specified surface grade of the compacted Leveling Base Aggregate material more than $\pm 1/2$ in. over a 10 ft. long straightedge laid in any direction.

3.05 SUBGRADE AND AGGREGATE BASE PREPARATION, METHOD B

- A. Utilize this method for preparing all subgrades and aggregate base course outside of tree root zones as indicated in the drawings.
- B. Compact soil subgrade uniformly to at least 90 percent of Standard Proctor Density per ASTM D 698 for pedestrian areas. Compact soil subgrade uniformly to at least 95 percent Modified Proctor per ASTM D 1557 for vehicular areas.
- C. Proof-roll prepared subgrade according to requirements in Division 31 Sections "Grading", "Excavation", "Trenching", and/or "Fill" to identify soft pockets and areas of excess yielding. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting and replace with compacted backfill or fill as directed.
- D. Mechanical tampers (jumping jacks) are recommended for compaction of soil subgrade and aggregate base around lamp standards, utility structures, building edges, curbs, tree wells and other protrusions. Compact areas, not accessible to roller compaction equipment, to the specified density with mechanical tampers.
- E. Proceed with care around the perimeters of excavations, buildings, curbs, etc. These areas are especially prone to consolidation and settlement. Do not place wedges of backfill in these areas. If possible, particularly in these areas, proceed with backfilling and compacting in shallow lifts, parallel to the finished surface.
- F. Leveling Base: Provide the Base Aggregate material in uniform lifts not exceeding 6 in. over the compacted subgrades and compact to at least 95 percent as per ASTM D 4254 to depths as indicated. Do not place fill on areas consisting of organic soil, debris, or other soft and yielding material. Do not place fill on frozen or muddy areas. Place, spread, and compact in uniform lifts for full width and length of stabilized aggregate surfacing and stonework areas. Place Leveling Base Aggregate, ensuring that moisture content remains constant and density is loose and constant until leveling and compaction.
- G. Compact the Leveling Base Aggregate material with at least two passes in the vibratory mode then at least two in the static mode with a minimum 10-ton vibratory roller until there is no visible movement. Do not crush aggregate with the compaction device.
- H. Tolerance: Do not exceed the specified surface grade of the compacted Leveling Base Aggregate material more than $\pm 1/2$ in. over a 10 ft. long straightedge laid in any direction.
- I. In-place density of the Leveling Base Aggregate materials may be checked per ASTM D 4254.

3.06 STABILIZED AGGREGATE SURFACING INSTALLATION

- A. Micro-grade and re-compact the Leveling Base Aggregate such that the surface crown or cross-slope indicated for the final surface is translated into the forming and shaping of the top surface of the base course.
- B. Inspect the Leveling Base Aggregate course prior to commencing the placement of the stabilized aggregate surface material. Acceptance of the Levelling Base Course occurs with the initiation of stabilized aggregate surface installation.
- C. Pre-blend (factory blend) crushed aggregate with stabilizer material prior to delivery to site. Install crushed aggregate with stabilizer material per manufacturer's written recommendations and to produce the final depths indicated in the Drawings.
- D. Moisture content of the stabilized aggregate pathway material must be monitored carefully prior to placement. Refer to manufacturer's installation guidelines for appropriate moisture content and adding moisture if stabilized aggregate pathway material becomes too dry during storage and/or transport and ensure adequate moisture content prior to placement.
- E. Set edging on top of prepared aggregate base course with L-shape flange pointing outward away from the edge of the path. Install and secure metal edging along outside edges of all stabilized aggregate pathways in accordance with manufacturer's written instructions. Anchor with aluminum stakes through the pre-punched holes in the bottom flaps of the L-shaped metal edge, spaced approximately 12 inches apart, driven into compacted aggregate base course below.
- F. Install stabilized aggregate pathway material in a single lift, taking into account compaction rate of the material, such that multiple lifts of material are not required. The manufacturer recommends over-placing material, compacting, and then removing any excess material by carefully scraping the top surface vs under-placing material, compacting, and having to add an additional lift of.
- G. Compact stabilized aggregate pathway with a hand-drum roller in 4-6 passes to 95% modified proctor density. Do not utilize vibratory compaction for compacting the aggregate pathway layer as it risks disassociating the bonds of the stabilized aggregate and allows fines and moisture to migrate to the surface, causing the surface to take on a smooth, concrete-like appearance.
- H. Apply a light spray of mist to the surface of the finished material to give it a clean appearance. Remove water source when water begins to run off of top surface.
- I. Final top surface shall be level, smooth and free from depressions or ridges and shall be finished level with adjacent stone edging, concrete pavement or metal edging.
- J. Where stabilized aggregate surface terminates at a vertical edge (concrete wall, concrete walkway, curb, etc.), finish stabilized aggregate surface up to the edge of the vertical face with no joint or gap between surfacing and vertical face.
- K. Rope or cordon off stabilized aggregate pavement areas from foot traffic until installation has fully cured. Coordinate recommended curing times with supplier based on moisture content at the time of installation, climate, weather patterns and depth of installation.
- L. Finishing: Place adjacent planting soils, mulches and surfaces as indicated in Drawings.

3.07 ADJUSTING

- A. Repair any stabilized aggregate pathways that are damaged after installation and during the course of the project's final construction by referring to supplier's written recommendations for repairing areas based on the size and type of repair required. Repaired areas shall not appear visually different from the field of the installation.

3.08 CLEAN-UP AND PROTECTION

- A. During installation, keep adjacent paving and construction clean and work area in an orderly condition.
 - B. Protect adjacent plants and surfaces from damage due to installation operations.
-

- C. Protect all installed landscape paving and surfacing for the duration of construction and through the final punch list curing. The Contractor will be required to make necessary repairs until the final punch list has been issued and any and all punch list items have been cured, after which City staff will take over maintenance and repairs of all landscape pathways.

3.09 DISPOSAL

- A. Remove any and all surplus and waste material including excess subsoil, unsuitable soil, trash, stone, mulches, accessories, and debris and legally dispose of them off the project site.

END OF SECTION

**SECTION 32 17 13
PARKING BUMPERS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Precast concrete parking bumpers and anchorage.

1.02 REFERENCE STANDARDS

- A. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2022.
- B. ASTM C33/C33M - Standard Specification for Concrete Aggregates 2023.
- C. ASTM C150/C150M - Standard Specification for Portland Cement 2022.
- D. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete 2010a (Reapproved 2016).
- E. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete 2023.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. See Section 31 02 00 - General Requirements for Sitework, for submittal procedures.
- C. Product Data: Provide unit configuration, dimensions.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Parking Bumpers: Precast concrete, complying with the following:
 - 1. Cement: ASTM C150/C150M, Portland Type I - Normal; white color.
 - 2. Concrete Materials: ASTM C330/C330M aggregate, water, and sand.
 - 3. Reinforcing Steel: ASTM A615/A615M, deformed steel bars; unfinished, strength and size commensurate with precast unit design.
 - 4. Air Entrainment Admixture: ASTM C260/C260M.
 - 5. Concrete Mix: Minimum 5,000 psi compressive strength after 28 days, air entrained to 5 to 7 percent.
 - 6. Use rigid molds, constructed to maintain precast units uniform in shape, size and finish. Maintain consistent quality during manufacture.
 - 7. Embed reinforcing steel, and drill or sleeve for two dowels.
 - 8. Cure units to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking.
 - 9. Minor patching in plant is acceptable, providing appearance of units is not impaired.

PART 3 EXECUTION**3.01 INSTALLATION**

- A. Install units without damage to shape or finish. Replace or repair damaged units.
- B. Install units in alignment with adjacent work.

END OF SECTION

SECTION 32 17 23 PAVEMENT MARKINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Painted pavement markings.

1.02 RELATED REQUIREMENTS

- A. Section 32 12 16 - Asphalt Paving.
- B. Section 32 16 23 - Sidewalks.
- C. Section 32 17 13 - Parking Bumpers.
- D. Section 32 17 26 - Tactile Warning Surfacing.

1.03 REFERENCE STANDARDS

- A. AASHTO M 237 - Standard Specification for Epoxy Resin Adhesives for Bonding Traffic Markers to Hardened Portland Cement and Asphalt Concrete 2005 (Reapproved 2019).
- B. AASHTO M 247 - Standard Specification for Glass Beads Used in Pavement Markings 2013 (Reapproved 2018).
- C. AASHTO M 249 - Standard Specification for White and Yellow Reflective Thermoplastic Striping Material (Solid Form) 2012 (Reapproved 2020).
- D. AASHTO MP 24 - Standard Specification for Waterborne White and Yellow Traffic Paints 2015 (Reapproved 2020).
- E. ASTM D4505 - Standard Specification for Preformed Retroreflective Pavement Marking Tape for Extended Service Life 2012 (Reapproved 2017).
- F. ASTM E303 - Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester 1993 (Reapproved 2018).
- G. FHWA MUTCD - Manual on Uniform Traffic Control Devices 2009, with Editorial Revision (2022).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work of this section with adjoining work.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by affected installers.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver glass beads in containers suitable for handling and strong enough to prevent loss during shipment, accompanied by batch certificate.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.08 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Do not apply paint if temperature of surface to be painted or the atmosphere is less than 50 degrees F or more than 95 degrees F.

1.09 SEQUENCING

- A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of markings.

PART 2 PRODUCTS**2.01 MANUFACTURERS****2.02 PAINTED PAVEMENT MARKINGS**

- A. Comply with State of Wisconsin Highway Department standards.
- B. Painted Pavement Markings: As indicated on drawings.

PART 3 EXECUTION**3.01 PREPARATION**

- A. Establish survey control points for locating and dimensioning of markings.
- B. Place barricades, warning signs, and flags as necessary to alert approaching traffic.
- C. Clean surfaces prior to installation.
 - 1. Remove dust, dirt, and other debris.

3.02 INSTALLATION

- A. General:
 - 1. Position pavement markings as indicated on drawings.
 - 2. Field location adjustments require approval of Architect.
- B. Painted Pavement Markings:
 - 1. Apply in accordance with manufacturer's instructions.
 - 2. Apply in accordance with State of Wisconsin Highway Department standards.

3.03 TOLERANCES

- A. Maximum Variation From True Position: 3 inches (76 mm).
- B. Maximum Offset From True Alignment: 3 inches (76 mm).

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Perform field inspection for deviations from true alignment or material irregularities.
- C. If inspections indicate work does not meet specified requirements, rework and reinspect at no cost to Owner.
- D. Allow the pavement marking to set at least the minimum time recommended by manufacturer.

3.05 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals for additional requirements.

3.06 PROTECTION

- A. Prevent approaching traffic from crossing newly applied pavement markings.
- B. Replace damaged or removed markings at no additional cost to Owner.
- C. Preserve survey control points until pavement marking acceptance.

END OF SECTION

SECTION 32 17 26 TACTILE WARNING SURFACING

PART 1 GENERAL

1.01 SECTION INCLUDES

1.02 RELATED REQUIREMENTS

- A. Section 31 02 00 - General Requirements for Sitework
- B. Section 03 30 00 - Cast-in-Place Concrete: Concrete for sidewalks and platforms.
- C. Section 32 13 13 - Concrete Paving: Concrete sidewalks.
- D. Section 32 17 23 - Pavement Markings: Crosswalk and curb markings.

1.03 REFERENCE STANDARDS

- A. 49 CFR 37 - Transportation Services for Individuals with Disabilities (ADA) current edition.
- B. AASHTO LRFD - Bridge Design Specifications 2020, with Errata (2021).
- C. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- D. ASTM A48/A48M - Standard Specification for Gray Iron Castings 2022.
- E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2023.
- F. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus 2019.
- G. ASTM C501 - Standard Test Method for Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser 2021.
- H. ASTM C903 - Standard Practice for Preparing Refractory Specimens by Cold Gunning 2015 (Reapproved 2020).
- I. ASTM D2047 - Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine 2017.
- J. ASTM D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Coating Systems 2020.
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023c.
- L. ASTM G155 - Standard Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials 2021.
- M. ATBCB PROWAG - Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way 2011.
- N. SAE AMS-STD-595 - Colors Used in Government Procurement 2017a.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. See Section 31 02 00 - General Requirements for Sitework, for submittal procedures
- C. Product Data: Submit manufacturer's product data, standard details, details specific to this project; written installation and maintenance instructions.
- D. Warranty: Submit manufacturer warranty; complete forms in Owner's name and register with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years documented experience.
- B. Installer Qualifications: Company certified in writing by product manufacturer as having successfully completed work substantially similar to the work of this section.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver to project site in manufacturer's protective wrapping and in manufacturer's unopened packaging.
- B. Store covered and elevated above grade and in manufacturer's unopened packaging until ready for installation. Maintain at ambient temperature between 40 and 90 degrees F.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Cast Iron Tiles: Provide manufacturer's standard ten year warranty against manufacturing defects, breakage or deformation.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Cast Iron Detectable Warning Plates:
 - 1. Neenah Foundry, a division of Neenah Enterprises, Inc.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 TACTILE AND DETECTABLE WARNING DEVICES

- A. Cast Iron Detectable Warning Plates:
 - 1. As directed on plans

PART 3 EXECUTION**3.01 EXAMINATION**

- A. When installation location is near site boundary or property line, verify required location using property survey.
- B. Verify that work area is ready to receive work:
 - 1. Examine work area with installer present.
 - 2. If existing conditions are not as required to properly complete the work of this section, notify Architect.
 - 3. Do not proceed with installation until deficiencies in existing conditions have been corrected.
- C. Verify that dimensions, tolerances, and attachment methods for work in this section are properly coordinated with other work on site.

3.02 INSTALLATION, GENERAL

- A. Install in accordance with manufacturer's written instructions.
 - 1. Do not install damaged, warped, bowed, dented, abraded, or otherwise defective units.
 - 2. Do not install when ambient or substrate temperature has been below 40 degrees F during the preceding 8 daylight hours.
- B. Field Adjustment:
 - 1. Locate relative to curb line in compliance with ATBCB PROWAG, Sections 304 and 305.
 - 2. Orient so dome pattern is aligned with the direction of ramp.
 - 3. Align truncated dome pattern between adjacent units.
- C. Install units fully seated to substrate, square to straight edges and flat to required slope.
- D. Align units so that tops of adjacent units are flush and joints between units are uniform in width.

3.03 INSTALLATION, CAST IN PLACE PLASTIC TILES

- A. Concrete:
 - 1. See Section 03 30 00.
 - 2. Slump: 4 to 7 percent.
- B. When installing multiple adjacent units, leave a 3/16 inch gap between units to allow for expansion.

- C. Tamp and vibrate units as recommended by manufacturer.
- D. Place and position weights on units while concrete cures as recommended by manufacturer. Ensure no voids or air pockets exist between top surface of concrete and underside of units.

3.04 INSTALLATION - CAST IN PLACE, CAST IRON PLATES

- A. Concrete: See Section 03 30 00.
- B. When installing multiple adjacent units, connect plates before placing.
- C. Install by method described in manufacturer's written instructions.
- D. Place units into wet concrete.
- E. Press assembly into concrete to achieve final elevation.
- F. Finish concrete adjacent to plate. Remove wet concrete spilled onto plate surface.

3.05 PROTECTION

- A. Protect installed units from traffic, subsequent construction operations or other imposed loads until concrete is fully cured.
- B. Touch-up, repair or replace damaged products prior to Date of Substantial Completion.

END OF SECTION

SECTION 32 31 13
CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

Chain link security fence within Storage Room 156.

- A. Posts, rails, and frames.
- B. Wire fabric.
- C. Manual gates with related hardware.
- D. Accessories.

1.02 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric; 2011a (Reapproved 2022).
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- E. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2023.
- F. CLFMI CLF-SFR0111 - Security Fencing Recommendations; 2014.
- G. FS RR-F-191/1D - Fencing, Wire and Post Metal (Chain-Link Fence Fabric); 1990.

1.03 SUBMITTALS

- A. See Section 01 33 23 - Submittals for City of Madison required submittal procedures.
- B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.
- C. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components. See CLFMI CLF-SFR0111 for planning and design recommendations.
- D. Manufacturer's Qualification Statement.
- E. Fence Installer Qualification Statement.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Fence Installer: Company with demonstrated successful experience installing similar projects and products, with not less than two years of documented experience.

1.05 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Chain Link Fences and Gates:
 - 1. Century Fence, Inc.; <https://www.centuryfence.com>
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 COMPONENTS

- A. Line Posts: 2.38 inch (60 mm) diameter.
- B. Corner and Terminal Posts: 2.38 inch (60 mm) diameter.
- C. Gate Posts: 3-1/2 inch (89 mm) diameter.
- D. Gate Frame: 1.66 inch (42 mm) diameter for welded fabrication.
- E. Fabric: 2 inch (51 mm) diamond mesh interwoven wire, 6 gauge, 0.1920 inch (4.9 mm) thick, top selvage knuckle end closed, bottom selvage twisted tight.
- F. Tension Wire: 6 gauge, 0.1920 inch (4.9 mm) thick steel, single strand.
- G. Tie Wire: Aluminum alloy steel wire.

2.03 MATERIALS

- A. Posts, Rails, and Frames:
 - 1. Formed from hot-dipped galvanized steel sheet, ASTM A653/A653M, HSLAS, Grade 50, with G90 (Z275) zinc coating.
 - 2. Line Posts: Type I round in accordance with FS RR-F-191/1D.
 - 3. Terminal, Corner, Rail, Brace, and Gate Posts: Type I round in accordance with FS RR-F-191/1D.
- B. Wire Fabric:
 - 1. ASTM A392 zinc coated galvanized steel chain link fabric.

2.04 MANUAL GATES AND RELATED HARDWARE

- A. Hardware for Double Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches (1,525 mm) high, 3 for taller gates; drop bolt on inactive leaf engaging socket stop set in concrete, active leaf latched to inactive leaf preventing raising of drop bolt, padlock hasp; keepers to hold gate in fully open position.
- B. Hinges: Finished to match fence components.
 - 1. Brackets: Round.
 - 2. Mounting: Center.
 - 3. Closing: Manual.
- C. Latches: Finished to match fence components.
 - 1. Brackets: Round.

2.05 ACCESSORIES

- A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.
- B. Surface mounting base: Base plate that bolts to the concrete slab. Galvanized steel finish. Provide concrete tapping screws for installation.
- C. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.

2.06 FINISHES

- A. Components (Other than Fabric): Galvanized in accordance with ASTM A123/A123M, at 1.7 ounces per square foot (530 g/sq m).
- B. Hardware: Hot-dip galvanized to weight required by ASTM A153/A153M.
- C. Accessories: Same finish as framing.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verification of Conditions: Verify that areas are clear of obstructions or debris.
-

3.02 PREPARATION

- A. Removal: Obstructions or debris.

3.03 INSTALLATION

- A. Install framework, fabric, accessories and gates in accordance with ASTM F567.

3.04 TOLERANCES

3.05 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Layout: Verify that fence installation markings are accurate to design, paying attention to gate locations, underground utilities, and property lines.
- C. Gates: Inspect for level, plumb, and alignment.

3.06 CLEANING

- A. Leave immediate work area neat at end of each work day.
- B. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
- C. Clean fence with mild household detergent and clean water rinse well.

END OF SECTION

**SECTION 32 33 00
SITE FURNISHINGS****PART 1 GENERAL****1.01 DESCRIPTION**

- A. Exterior site furnishings, materials, and assemblies.

1.02 RELATED WORK AND REQUIREMENTS

- A. Applicable provisions of Division 01 shall govern Work of this Section.
- B. Section 03 30 00 - Cast-in-Place Concrete: for formed and poured concrete walls, backings and/or other constructions that the work in this section attaches to or relies on cast-in-place concrete for footings and/or foundations.
- C. Section 13 34 16 - Pre-Engineered Structures – Solar Forma: for coordination of infrastructure for future solar tree.
- D. Section 32 14 13.13 - Miscellaneous Landscape Surfaces: for coordination with aggregate paths and aggregate base materials and installations.
- E. Section 32 13 13 - Concrete Paving: for flatwork concrete pavement surfaces that site furnishings will attach to or install on.

1.03 SUBMITTALS

- A. Product Data: Manufacturer's cut sheet for each different type of premanufactured site furnishing or product listed in this section, including all components. Cut sheet should indicate final style selection, colors choices, materials, etc. consistent with this section and shall indicate if any additional selections are required of the Landscape Architect prior to ordering.
- B. Warranty Certificates: For all site furnishings and products listed in this section.
- C. Maintenance Data: For site furnishings and products listed in this section to include in O&M manuals.
- D. Submit markup of project construction details indicating any proposed deviations from the Working Drawings; obtain approval of markups prior to construction.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of site furnishing(s) through one source from the manufacturer indicated in this section.
- B. Installer Qualifications: The installer of all site furnishings must have a minimum of 2 years of proven construction experience, be capable of assembling and building from manufacturer's assembly instructions, plan drawings and details, determine elevations and properly handle materials, including custom assemblies and constructions requiring close coordination with other contractors (for lighting, metals, concrete, etc.). All work must comply with the project drawings and approved shop drawings.
- C. Preinstallation Conference: Conduct conference at Project site to verify final location and orientation of all site furnishings with Landscape Architect and City of Madison Representative in attendance prior to installation. Obtain Landscape Architect or City of Madison Representative's written sign-off prior to final installation and anchoring/placing each individual site furnishing unit.
- D. Refer to each individual manufacturer for information on delivery, storage, handling, and quality assurance and conform the work of this section to any and all specific conditions of those sections.

1.05 COORDINATION

- A. Coordinate installation of all site furnishings with all local codes and ordinances.
- B. Coordinate with other contractors working on adjacent portions of the site and/or those whose work affects any of the custom assemblies and constructions (i.e., electrical).
- C. Coordinate the ordering and delivery of all products so as to cause no delays in the overall project schedule, the work of others, or the occupancy of the project.

PART 2 PRODUCTS

2.01 MISCELLANEOUS HARDWARE

- A. Anchors, Fasteners, Fittings, and Hardware: Stainless steel grade 316; commercial quality; tamperproof, vandal and theft resistant.

2.02 BIKE RACK

- A. Basis of Design: Complying with the requirements, provide the following bike racks from Madrax (www.madrax.com), or approved equal:
1. Model: PIN-2-SF. "Pin" Bike Rack, 2-bike capacity. Round tubing. 2'-2" L.
 2. Mounting Type: Surface mounted.
 3. Finish: Powdercoated by manufacturer.
 4. Color: As selected by Landscape Architect from manufacturer's standard full range.
- B. Hardware: Provide manufacturer's supplied tamper-resistant stainless-steel anchors or comparable contractor-supplied stainless-steel anchors. Size shall be coordinated with pre-punched opening size for hardware in pre-manufactured units and length coordinated with the minimum embedment depths into concrete pavement

2.03 BIKE REPAIR STATION WITH PUMP

- A. Bike Repair Station Basis of Design: Complying with the requirements, provide the following bike repair station from Saris Infrastructure (www.sarisinfrastructure.com), or approved equal:
1. Model: Delux Public Work Stand, #26347BLK.
 2. Mounting Type: Surface mounted.
 3. Finish: Powdercoated by manufacturer.
 4. Color: Black.
- B. Pump Accessory: Complying with the requirements, provide the following bike pump from Saris Infrastructure (www.sarisinfrastructure.com), or approved equal:
1. Model: Outdoor Public Bike Pump with Gauge and "Long Hose" option, #26246.
 2. Finish / Color: Stainless steel, standard manufacturer's SS finish.
 3. Mounting Type: Surface mounted (floor mount) independently from the bike repair station.
- C. Hardware: Contractor-supplied, tamper-resistant stainless-steel concrete anchors. Size shall be coordinated with pre-punched opening size for hardware in pre-manufactured units and length coordinated with the minimum embedment depths into concrete pavement.

2.04 GRILL, SMALL

- A. Basis of Design: Complying with the requirements, provide the following small grills from Anova (www.anovafurnishings.com), or approved equal:
1. Small Grill Model: #100PRG-SM. 10" (ht) x 20" (w) x 15" (d) firebox, heavy-duty, single adjustable rack, adjustable ADA steel park grill with 300 square inches of cooking surface and steel post with surface mount base with 360-degree swivel, and theft-proof post-to-top locking device. 34" total height when assembled (from grade).
 2. Finish / Color: Non-toxic black powdercoat.
- B. Hardware: Hardware: Contractor-supplied, tamper-resistant stainless-steel concrete anchors. Size shall be coordinated with pre-punched opening size for hardware in pre-manufactured units and length coordinated with the minimum embedment depths into concrete pavement.

2.05 GRILL, MEDIUM

- A. Basis of Design: Complying with the requirements, provide the following large grills from Anova (www.anovafurnishings.com), or approved equal:
1. Medium Grill Model: #150PRG. 10" (ht) x 20" (w) x 32" (d) firebox, heavy-duty, double adjustable racks, steel park grill with 600 square inches of cooking surface and steel post supposed by a heavy-duty 4" square gusseted post and base for surface mounting. 34 1/8" total height when assembled (from grade).

2. Finish / Color: Non-toxic black powdercoat.
- B. Hardware: Contractor-supplied, tamper-resistant stainless-steel concrete anchors. Size shall be coordinated with pre-punched opening size for hardware in pre-manufactured units and length coordinated with the minimum embedment depths into concrete pavement.

2.06 ASH URN

- A. Basis of Design: Complying with the requirements, provide the following coal/ash urns from Petersen Manufacturing Co. (www.petersenmfg.com), or approved equal:
 1. Model: #500-0715 w/ Center Anchor Hole. 35" (ht) x 22" (sq.), 30-gallon, reinforced concrete receptacle with removable steel grate and steel door for emptying; includes standard (4) 1" diameter drainage holes in bottom and a 12" square "Hot Ash Only" sign integrated into the urn.
 2. Customization: Contractor shall indicate that manufacturer is required to customize the standard unit to include a full-depth, 1/2" dia. opening, centered in base (bottom) of each precast ash urn unit.
 3. Color/Finish: Sand Tan-Smooth Concrete.
- B. Hardware: Hardware: Contractor-supplied, tamper-resistant stainless-steel concrete anchors. Size shall be coordinated with pre-punched opening size for hardware in pre-manufactured units and length coordinated with the minimum embedment depths into concrete pavement.

2.07 PRECAST CONCRETE BENCHES

- A. Basis of Design: Complying with the requirements, provide the following Urbastyle series, pebble-shaped precast concrete benches from Wausau Tile (www.wausautile.com), or approved equal:
 1. Model: Galet, in the following size/configurations as indicated in the drawings:
 - a. PCB-1: ZB.GL.01. 50" (l) x 50" (w) x 16" (ht). Color/Finish: A22 – Sand.
 - b. PCB-2: ZB.GL.02. 63" (l) x 63" (w) x 19.5" (ht). Color/Finish: A23 – Grey.
 - c. PCB-3: ZB.GL.03. 94" (l) x 52" (w) x 17" (ht). Color/Finish: A20 – White.
 - d. PCB-4: ZB.GL.04. 96" (l) x 70" (w) x 17" (ht). Color/Finish: A26 – Charcoal.
 - e. PCB-6: ZB.GL.06. 72" (l) x 72" (w) x 17 1/2" (ht). A21 – Buff.
 2. Mounting Type: Freestanding (no hardware or anchors)
 3. Finish: Acid wash.
 4. Color: As selected by Landscape Architect from manufacturer's standard full range. Note: multiple colors may be selected.
- B. Hardware: n/a.

2.08 PICNIC TABLE

- A. Basis of Design: Complying with the requirements, provide the following freestanding picnic tables from Thomas Steele (www.thomas-steele.com), or approved equal:
 1. Model: "Monona" freestanding picnic table, in the following size/configurations as indicated in the drawings:
 - a. PT: MNTFS-8. Dining Height. 8-foot length. Metal frame with recycled plastic top. Standard configuration.
 - b. PT-HC: MNTFS-8HC. Dining Height. 8-foot length. Metal frame with recycled plastic top. Accessible wheelchair configuration.
 2. Mounting Type: Freestanding (no hardware or anchors)
 3. Metal Finish and Color: Powdercoated finish by manufacturer. Color: Bronze.
 4. Recycled Plastic Size and Color: 3" x 4" profile, recycled plastic slats. Color: Mahogany.
- B. Hardware: n/a.

2.09 MOVEABLE TABLE, LARGE

- A. Basis of Design: Complying with the requirements, provide the following large, moveable tables from Thomas Steele (www.thomas-steele.com), or approved equal:
 1. Model: CFT-42-P-DSK 'Cafe' table, 42" diameter, with solid steel top and disk base.

2. Mounting Type: Freestanding (no hardware or anchors)
3. Finish: Powdercoated by manufacturer.
4. Color: As selected by Landscape Architect from manufacturer's standard full range.

B. Hardware: n/a.

2.10 MOVEABLE TABLE, SMALL

A. Basis of Design: Complying with the requirements, provide the following small, moveable tables from Thomas Steele (www.thomas-steele.com), or approved equal:

1. Model: TET-30-P 'Terrace' table, 30" diameter, with solid steel top and disk base.
2. Mounting Type: Freestanding (no hardware or anchors)
3. Finish: Powdercoated by manufacturer.
4. Color: As selected by Landscape Architect from manufacturer's standard full range.

B. Hardware: n/a.

2.11 MOVEABLE CHAIRS

A. Basis of Design: Complying with the requirements, provide the following stackable metal chairs with arms from Landscape Forms (www.landscapeforms.com), or approved equal:

1. Model: 'Chair 21', with arms. 25.5" x 25.75" x 32.75", stackable. Include manufacturer's bumpers/glides at each leg to resist damage from dragging on rough surfaces.
2. Mounting Type: Freestanding (no hardware or anchors)
3. Finish: Powdercoated by manufacturer.
4. Color: As selected by Landscape Architect from manufacturer's standard full range.

B. Hardware: n/a.

2.12 LITTER RECEPTACLE

A. Basis of Design: Complying with the requirements, provide the following litter receptacles from Thomas Steele (www.thomas-steele.com), or approved equal:

1. Model: 'Windsor' Receptacle.
 - a. LR-T: WNTR-32-P & LID-ED-P 'Windsor' receptacles for trash with elevated dome lid. Include standard decal for trash receptacles; letter color to be selected by Landscape Architect from manufacturer's standard full range.
 - b. LR-R: WNTR-32-P & LID-F-P 'Windsor' receptacles for recycling with flat lid. Include standard decal for recycling receptacles; letter color to be selected by Landscape Architect from manufacturer's standard full range
2. Mounting Type: Freestanding (no hardware or anchors).
3. Finish: Powdercoated by manufacturer.
4. Color: As selected by Landscape Architect from manufacturer's standard full range. Note: Separate colors may be selected for body of receptacles and each lid type (trash or recycling).

B. Hardware: n/a.

2.13 BOLLARD, DECORATIVE

A. Basis of Design: Complying with the requirements, provide the following decorative bollards from Forms + Surfaces (www.forms-surfaces.com), or approved equal:

1. Model: LBLHO-603-N. 'Helio', Series 600, non-illuminated outdoor bollard.
2. Mounting Type: Surface mounted with J-bolts per manufacturer's standard product offerings
Finish: Powdercoated by manufacturer.
3. Color: As selected by Landscape Architect from manufacturer's standard full range.

B. Hardware: Contractor may be required to furnish and install additional stainless-steel hardware to install each bollard unit fully and completely in compliance with manufacturer's written and graphic installation instructions.

2.14 BOLLARD, UTILITY

- A. Provide 6" o.d. x 8-foot length Schedule 40 galvanized steel pipe, filled with concrete and set into concrete footing at each location indicated in the drawings.
- B. Polyethylene Cover: Provide high-density, 1/8" thick polyethylene bollard cover for 6" o.d. pipe.
 - 1. Color: Submit manufacturer's standard full range of colors and colored/reflective tape options for final selections by Landscape Architect.
 - 2. Optional reflective tape and/or colored tape to be added at the request of City of Madison Representatives and/or Landscape Architect at no additional cost to the project. Up to two (2) reflective or colored strips per bollard.
- C. Concrete: Refer to Section 03 30 00, "Cast-in-Place Concrete" for concrete footings.

2.15 BOLLARD, SAFETY

- A. Provide 4.5" o.d. x 48" ht. steel bollard constructed of 10 ga. steel with integrally welded 8" x 8" x 1/4" steel mounting plate for surface mounting.
- B. Basis of Design: Complying with the requirement, provide the following safety bollards from Global Industrial (www.globalindustrial.com), or approved equal.
 - 1. Model #T9F337327R, Steel Safety Bollard w/ Black Hazard Tape.
 - 2. Color: Safety Yellow with Black Hazard Tape.
- C. Hardware: Furnish and install stainless steel anchoring hardware to match pre-drilled mounting holes in base plate of each bollard. Qty. 4 per bollard. Hardware length shall provide min. 3" embed and be specifically designed for concrete anchoring.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 2. Report any damage to adjacent surfaces. Do not proceed with installation until all unsatisfactory or damaged adjacent conditions have been documented and corrected.

3.02 INSTALLATION, GENERAL

- A. Place or otherwise demarcate the location and orientation for each individual site furnishing unit on site and request field review from City of Madison Representative and Landscape Architect of orientation and location for all site furnishings prior to installation or placement.
- B. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of all site furnishings, custom assemblies, and constructions.
- C. Supply and install all hardware associated with full and complete product unit installations.
- D. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed. Ensure that concrete has fully cured prior to installing any site furnishings into or setting on top of concrete pavements.
- E. Install site furnishings level, plumb, true, and securely anchored (only anchoring if indicated) at locations indicated on Drawings.
- F. For all surface-mounted site furnishings, ensure that furnishings are placed such that the minimum distance between anchoring hardware and edge of concrete slab is no less than 4-inches to ensure that anchoring doesn't compromise concrete pavement integrity.

3.03 INSTALLATION, PRECAST CONCRETE BENCHES

- A. For Precast Concrete Benches in Landscape Areas: Prepare subgrades and aggregate base course in accordance with Section 32 14 13.13 - Miscellaneous Landscape Surfaces; Subgrade and Aggregate Base Preparation, Method A or B as indicated in the drawings.
- B. For Precast Concrete Benches in Paved Areas: Examine concrete to ensure that it has fully cured.
- C. Place precast concrete benches on top of prepared aggregate base or concrete pavement, depending on location, after obtaining sign off of final placement and orientation.
- D. Ensure benches are level, stable and do not rock, tip or otherwise move.

3.04 PROTECTION AND REPAIR

- A. Protect all adjacent pavements, surfaces and landscapes from damage at all times during site furnishings storage, assembly, and installation.
- B. Any and all damage to site furnishings shall be reviewed by City of Madison Representative and Landscape Architect to determine whether field repairs can be performed sufficiently to correct the damage or whether the furnishing shall be removed and replaced. Contractor is responsible for removal and replacement of any and all furnishings deemed to be damaged beyond repair at no additional cost to the City.
- C. Field repair of any precast concrete units is unacceptable; contractor will be required to replace damaged precast concrete units with new units.

3.05 CLEANING

- A. After completing site furnishing, custom assemblies, and constructions installation, inspect components. Remove spots, dirt, and debris. Repair damaged finishes to match original finish or replace component.

END OF SECTION

**SECTION 32 35 00
SITE SCREENING DEVICES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pre-Formed Panels: For screening or buffering trash enclosures, utility areas, privacy areas, mechanical units, etc.
 - 1. Plankwall PVC (Polyvinyl Chloride).
 - 2. Powder coated metal.
 - 3. NatureScreen trellis.
- B. Aluminum Support Framing: For direct attachment of screen support columns to/into concrete pads, piers, or footings provided by others.
- C. Operable gates for access through screens.
- D. Not Included in This Specification:
 - 1. Touch-up painting required for scratches and screw heads.
 - 2. Field painting of prime painted screens

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM B 221 - Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire Profiles, and Tubes.
- B. The Aluminum Association, Inc. (AA):
 - 1. AA ADM-1516166 - Aluminum Design Manual
- C. American Society of Civil Engineers (ASCE):
 - 1. ASCE 7-18 - Minimum Design Loads for Buildings and Other Structures.

1.03 SUBMITTALS

- A. See Section 01 33 23-Submittals for City of Madison required submittal procedures. .
- B. Product Data:
 - 1. Manufacturer's data sheets on each product to be used.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Typical installation methods.
 - 5. Sufficient data and detail to indicate compliance with these specifications.
- C. Verification Samples: Two representative units of each panel type.
 - 1. Color Selection: Submit paint chart with full range of colors available for Architect's selection. Custom color samples available upon purchase.
- D. Shop Drawings: Indicate layout heights, component connection details, and details of interface with adjacent construction.
- E. Certification: Manufacturer's Certificate of Compliance certifying that panels supplied meet or exceed requirements specified.
- F. Closeout Submittals: Warranty documents, issued and executed by manufacturer, countersigned by Contractor.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum of one (1) year documented experience.
- B. Installer Qualifications: Company specializing in performing Work of this section with minimum two years documented experience with projects of similar scope and complexity.

- C. Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity.

1.05 PRE-INSTALLATION CONFERENCE

- A. Convene a conference approximately two weeks before scheduled commencement of the Work. Attendees shall include Architect, Contractor and trades involved. Agenda shall include schedule, responsibilities, critical path items and approvals.
 - 1. Notify Architect four (4) calendar days in advance of scheduled meeting date.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.
- B. Storage and Handling: Protect materials and finishes during handling and installation to prevent damage.
- C. Protect from damage due to weather, excessive temperature, and construction operations.

1.07 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.
- B. Field Measurements: Take measurements of supporting paving, footings, or piers. Indicate measurements on shop drawings fully documenting any field condition that may interfere with the screen system installation.

1.08 COORDINATION

- A. Installer for work under this Section shall be responsible for coordination of panel and framing sizes and required options with the Contractor's requirements.
 - 1. Request information on sizes and options required from the Contractor.
- B. Submit shop drawings to the Contractor and obtain written approval of shop drawing from the Contractor prior to fabrication.
- C. Confirm size, type, and location of supporting construction as adequate to resist column supports.

1.09 WARRANTY

- A. If any part of the screen system fails because of a manufacturing defect within 1 to 5 years from the date of substantial completion, the manufacturer will furnish the required replacement parts without charge. Any local transportation, related service labor, or diagnostic call charges are not included.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: CityScapes International Inc.,
 - 1. 4200 Lyman Ct., Hilliard, OH 43026; Toll Free: 877-SCREENS; Phone: 614-850-2549; Email: contact@cityscapesinc.com; Web: <https://cityscapesinc.com/>
- B. Substitutions:
 - 1. Not permitted.
 - 2. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Regulatory Requirements: Comply with requirements of building authorities having jurisdiction in Project location.
- B. Design Criteria: Manufacturer is responsible for the structural design of all materials, assembly, and attachments to resist snow, wind, suction and uplift loading at any point without damage or permanent set.

1. Framing: Designed in accordance with the Aluminum Design Manual to resist the following loading:
 - a. ASCE 7-18 - Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers.

2.03 MATERIALS

- A. Basis of Design: Covrit Gates and Screening Systems by CityScapes International Inc.
- B. Screening Paneling:
 1. Minimum Thickness: 0.050 inch
 2. Panel Infill:
 - a. Plankwall, PVC (Polyvinyl Chloride).
- C. Operable Access Gates:
 1. Minimum Panel thickness: 0.050 inch
 2. ToughGate Panel Infill:
 - a. PVC (Polyvinyl Chloride) sheets.
- D. Framing: Aluminum Plate, Shapes and Bar: ASTM B221, alloy 6005-T5, 6061-T5 or 6063-T6.
- E. Threaded Fasteners: Screws, bolts, nut and washers to be Stainless Steel.
 1. Post Backer assembly fasteners shall be #10-16 stainless steel Self-Drilling screws.
 2. Provide lock washer or other locking device at all bolted connections.

2.04 FABRICATION

- A. Factory-Formed Panel Systems: Continuous interlocking panel connections and indicated or necessary components.
 1. Form components true to shape, accurate in size, square and free from distortion or defects. Cut panels to precise lengths indicated on approved shop drawings.
- B. Fabricate products to the following configurations:
 1. Panel Style: Plankwall vertical.
 2. Panel and Gate Height: Custom. See drawings.
 3. Gate Width: Custom. See drawings.
 4. Column Cap Style: Shallow Hip aluminum.
 5. Dumpster Layout: See drawings.
 6. Trim and Closures: Fabricated and finished with Manufacturer's standard coating system, unless shown otherwise on drawings.
- C. Framing: Fabricate and assemble components in largest practical sizes, for delivery to the site.
 1. Construct corner assemblies to required shape with joints tightly fitted.
 2. Supply components required for anchorage of framing. Fabricate anchors and related components of material and finish as required, or as specifically noted.
 - a. 5/8 inch x 9 inch HILTI Epoxy Hardware Assembly
- D. Gate Hardware: Provide manufacturer's adjustable standard of size required to fit support pipe provided.
 1. Hinge Type: Barrel.
 2. Modern Latch

2.05 FINISHES

- A. Aluminum Framing: Mill finish.
- B. Panel Coating: Manufacturer's standard powder coating system, factory applied.
 1. Color: Selected from full range of manufacturer's standard colors.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Installer's Examination: Examine conditions under which construction activities of this section are to be performed.
 - 1. Submit written notification to Architect and Screen manufacturer if such conditions are unacceptable.
 - 2. Beginning erection constitutes installer's acceptance of conditions.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install units in accordance with the manufacturer's instructions and approved shop drawings. Keep perimeter lines straight, plumb, and level. Provide brackets, anchors, and accessories necessary for complete installation.
- B. Fasten structural supports to/into paving, footings, or piers at spacing as indicated on approved shop drawings.
- C. Metal Separation: Where aluminum materials would contact dissimilar materials, insert rubber grommets at attachment points, thus eliminating where dissimilar metals would otherwise be in contact.
- D. Do not cut or abrade finishes which cannot be restored. Return items with such finishes to shop for required alterations.

3.04 ERECTION TOLERANCES

- A. Maximum misalignment from true position: 1/4 inch (6 mm).

3.05 CLEANING AND PROTECTION

- A. Remove all protective masking from material immediately after installation.
- B. Protection:
 - 1. Ensure that finishes and structure of installed systems are not damaged by subsequent construction activities.
 - 2. If minor damage to finishes occurs, repair damage in accordance with manufacturer's recommendations; provide replacement components if repaired finishes are unacceptable to Architect.
- C. Prior to Substantial Completion: Remove dust or other foreign matter from component surfaces; clean finishes in accordance with manufacturer's instructions.
 - 1. Clean units in accordance with the manufacturer's instructions.

END OF SECTION

**SECTION 32 91 13
SOIL PREPARATION****PART 1 GENERAL****1.01 DESCRIPTION**

- A. Topsoil requirements and soil materials for at-grade plantings including sampling and testing, quality requirements, soil additives and amenities, and soil material depths.

1.02 RELATED WORK AND REQUIREMENTS

- A. Applicable provisions of Division 01 shall govern Work of this Section.
- B. Section 01 57 13 - Temporary Erosion and Sediment Control: for erosion materials coordination.
- C. Section 31 22 00 - Grading: for coordination with excavation and subgrade preparation work.
- D. Section 32 92 19 - Seeding: for seeded lawns and native plant mixes.
- E. Section 32 92 23 - Sodding: for sodded lawns.
- F. Section 32 93 00 - Plants: for project plantings and at-grade landscape materials.
- G. Refer to Civil Engineer's plans, plan notes, and details for information related to engineered soil composition, standards and construction of biofiltration areas.

1.03 REFERENCES

- A. State of Wisconsin, Department of Transportation, Standard Specifications for Highway and Structures Construction (WisDOT SSHSC). Current edition.
- B. City of Madison Standard Specifications for Public Works Construction. Current edition.
- C. Wisconsin Department of Natural Resources (DNR) Specification S100 – Compost.
- D. ASTM D5268 - Standard Specification for Topsoil Used for Landscaping.

1.04 SUBMITTALS

- A. The Contractor shall submit a one-page typewritten document for coordinating soil sample collection to the Landscape Architect at least ten (10) working days in advance of topsoil sample collection. The document shall include the name of the contractor, the date, the name of the quarry or property owner where topsoil will be mined if using mined material, the source of the topsoil stockpile if using stockpiled material, the location within the project site where topsoil will be obtained for any stripped and salvaged topsoil, the current and historic use of each of the sites/locations where intended topsoil collection will occur, and the approximate quantities the Contractor intends to use from each different source. The document shall include maps of the areas where intended topsoil will be taken from with notation indicating the context as well as the exact locations where topsoil mining or stripping and stockpiling will occur.
- B. Test Results: For all soil tests.
- C. Compost: Provide documentation indicating that the compost intended for use on the project meets the requirement of DNR S100 and any additional requirements outlined in this Section.
- D. Herbicide: Provide manufacturer's product data for herbicide(s) intended to be used to control weed growth on any existing topsoil stockpiled for re-use on this project site for review and approval prior to beginning herbicide applications.
- E. Weed Treatment Log and Soil Preparation Schedule of Reviews: Submit completed, typewritten logs and schedules for inclusion in the O&M manual for the project. Refer to Sections 3.1 and 3.2 for additional information.
- F. Sand: Provide documentation, including sieve analysis, that the sand intended for use on the project meets the requirements of WisDOT SSHSC and any additional requirements outlined in this Section.

1.05 QUALITY ASSURANCE FOR TOPSOIL MATERIALS

- A. Soil-Testing Laboratory Qualifications: An independent Laboratory or University Laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed. The independent laboratory must be able to provide all testing and analyses under one roof; using multiple laboratories for testing and/or analysis is not acceptable unless pre-approved by the Landscape Architect.
- B. Site-Wide Weed Control: Contractor shall continuously work to identify the presence of specific broadleaf weed or aggressive or invasive species and control of both annual and perennial weeds for the entire project site from the time of contract award to the time of final turfs and grasses installation and establishment, through the end of the maintenance and warranty period. The Contractor shall periodically visit the site at various times during the growing season, even prior to turfs and grasses installation, to update evaluations and treatment recommendations and to tailor the specific management plans to the anticipated dates of landscape installation; visits shall continue through the duration of the maintenance period.

1.06 SOIL SAMPLING AND TESTING

- A. The Contractor is fully responsible for coordinating the collecting soil samples for any soil materials stockpiled on site or from other sources that are intended to be used on the project.
 - 1. Contractor will be fully responsible for scheduling the collection, submittal and analysis of all soil samples within the overall project schedule. Note that it may take a substantial amount of time to get analysis of sample information back from a soil-testing laboratory and the Contractor shall not delay the project by failure to submit soil samples for analysis in a timely manner.
 - 2. Collection shall be completed in accordance with accepted practices.
 - a. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
 - b. Generally mined topsoil testing samples shall be collected in accordance with the "Sampling Lawn and Garden Soils for Analysis," available at:
 - 1) <https://door.extension.wisc.edu/files/2022/03/Sampling-Lawn-and-Garden-Soils-A2166.pdf>
 - c. The Contractor may contact the soil-testing laboratory to obtain instructions on sampling, depth, location, and number of samples to be taken and additional instructions on handling, packaging and delivering samples in a timely manner to the laboratory.
 - d. Provide a minimum of two (2) separate samples from each stockpile location or source (including separate locations or stockpiles from within the same source), or any other non-contiguous topsoil locations that may have variability apart from the other sources in order to provide an accurate indication of topsoil quality for each separate topsoil source.
 - B. Contractor shall clearly designate an alpha-numeric label for each sample location and shall compile a one-page typewritten document indicating the number of samples taken, sample location descriptions, alpha-numeric designation of each sample location, and a map or diagram indicating the location and alpha-numeric designation of each sample.
 - 1. The Contractor shall immediately submit the samples to the testing laboratory. Contractor shall use alpha-numeric designation when submitting samples to the soil testing laboratory to coordinate tests with soil sample description and map.
 - 2. The Contractor is responsible for facilitating the sampling and submitting to and coordinating with the testing laboratory. All soil testing and re-testing (if necessary) will be at the Contractor's expense.
 - C. Soil Analysis and Testing: For all individual topsoil samples, a written report by the soil-testing laboratory shall be submitted to the Landscape Architect and shall report the suitability of the tested soil for each the following categories:
 - 1. Lawn – New Bluegrass Lawn from Seed -AND- Garden Soil – Mixed Planting Bed.
 - D. When submitting the samples for analysis, the Contractor shall indicate on the testing form that analysis and results are needed for the following categories/tests (note: additional fees, category check-boxes on submittal form, etc., may be required to cover this suite of testing):
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1. pH
 2. Texture / Physical Analysis: including percentages of sand, silt, and clay (USDA Textural Class)
 3. Amount of Phosphorous (P)
 4. Amount of Potassium (K)
 5. Percent Organic Matter
 6. Total Carbon (C), Total Nitrogen (N), and C:N Ratio (on UW-Madison form, hand-write the request for this additional test on the standard submission form)
 7. Soluble Salts (in ds/M)
 8. Heavy Metal Testing.
- E. Report suitability of tested soil for turf and plant growth.
- F. Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
- G. Report presence of problem salts, minerals, or heavy metals. If such problem materials are present, provide additional recommendations for corrective action.
- H. The Landscape Architect retains the right to reject topsoil(s) for use on project based on any testing results that are outside the standard ranges of acceptability, would require prohibitive means and methods to correct, and/or contain unacceptable levels of salts, heavy metals, other contaminants or are of a USDA textural class unsuitable for the use on this project. Rejection of any topsoil(s) will require the Contractor to obtain new source(s) for topsoil, re-test, and re-submit results for review and approval.

PART 2 PRODUCTS

2.01 TOPSOIL

- A. The Project will accept only clean, salvaged or imported material capable of passing the 1" sieve, free of rocks, gravel, wood, debris, and of noxious weeds and their seeds and within the following acceptable ranges:
1. pH: 6.0 - 7.5
 2. USDA soil texture classification: Loam, Sandy Loam, Silty Loam, or Sandy Clay Loam
 3. Amount of Phosphorous (P): 6 – 10 ppm
 4. Amount of Potassium (K): 51 – 100 ppm
 5. Percent Organic Matter: 5% – 8%
 6. C:N Ratio: 12:1 to 15:1
 7. Soluble Salts (in ds/M): 0-2 dS/m
 8. Gravimetric Field Moisture Capacity (expressed as grams of water per 100 grams of oven dry soil): >15%
 9. Heave Metals Testing:
 - a. Heavy Metal (Cd): 0.01 – 3.0 ppm
 - b. Heavy Metal (Co): 1.0 – 40.0 ppm
 - c. Heavy Metal (Cr): 5.0 – 1000.0 ppm
 - d. Heavy Metal (Cu): 2.0 – 100.0 ppm
 - e. Heavy Metal (Fe): 10,000 – 50,000 ppm
 - f. Heavy Metal (Mn): 100 – 4,000 ppm
 - g. Heavy Metal (Mo): 0.5 – 40.0 ppm
 - h. Heavy Metal (Ni): 1.0 – 200.0 ppm
 - i. Heavy Metal (Pb): 2.0 – 200.0 ppm
 - j. Heavy Metal (Zn): 10 – 300 ppm
 - k. Heavy Metal (Li): 1.2 – 98.0 ppm
- B. Additional Properties of all Topsoil:

1. Naturally fertile, agricultural soil, capable of sustaining vigorous growth, of uniform composition throughout.
 2. Screened and free of stones ¼-inch or larger in any dimension; free of roots, plants, sod, clods, clay lumps, pockets of coarse sand, paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials harmful to plant growth.
 3. Free of noxious weeds and invasive plants including quack grass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bent grass, wild garlic, ground ivy, perennial sorrel, and brome grass.
 4. Not infested with nematodes; grubs; or other pests, pest eggs, or other undesirable organisms and disease-causing plant pathogens
 5. Friable and with sufficient structure to give good tilth and aeration. Continuous, air-filled pore space content on a volume/volume basis shall be at least 15 percent when moisture is present at field capacity. Soil shall have a field capacity of at least 15 percent on a dry weight basis.
- C. Additional Properties of Stripped, Salvaged or Mined Topsoil: Conforming to all other requirements in this Section and taken from the top 6-inches of the A-horizon, having deep brown to black color with a granular structure and clay content of less than 25%, verified with a ribbon test that yields no more than 1-inch.
- D. Topsoil shall meet all the requirements outlined in this Section and topsoil results shall be reviewed and approved by the Landscape Architect before topsoil delivery to site or use on project.
- E. Any adjustments to pH, nutrient content, or soil texture class shall be performed off-site and pre-blended before spreading; re-testing of blended topsoil will be required to confirm conformance with the ranges outlined in this section.
- F. Final topsoil is subject to approval by Landscape Architect based on submitted laboratory soil test results. Testing results shall be reviewed and approved, in writing, before any blending, delivery to, or use on the project site.
- G. Soil Materials: Soil Materials refers to either tested and approved topsoil (with amendments, if required) and/or planting soil which is a blend of approved topsoil, blended with soil amendments specified in this Section and subject to final proportion adjustments by A/E to produce acceptable planting soil for the project.

2.02 SAND

- A. Sand shall comply with the requirements of USDA Coarse Sand (0.02-0.04 inches) or ASTM C33 (Fine Aggregate Concrete Sand).
- B. Sand shall be washed and drained to remove clay and silt particles prior to using in soil blends or planting profiles.
- C. Manufactured stone dust is not allowed.
- D. Provide laboratory analysis for particle size or a simplified dispersal method for sand content to verify soil texture and submit the results for review and approval prior to delivery or installation on-site.

2.03 COMPOST

- A. Provide compost complying with the requirements for Compost in DNR Specification S100 – Compost and the following requirements:
 1. Particle Size – 98% of the compost shall pass through a 0.75-inch screen.
 2. Physical Contaminants – Less than 1% combined glass, metal and/or plastic.
 3. Organic Matter / Ash Content – At least 40% organic matter, less than 60% ash content.
 4. Carbon-Nitrogen Ratio – 10:1 to 20:1, C:N ratio.
 5. pH – Between 6 and 8.5.
 6. Soluble Salts – electrical conductivity below 10 dS m⁻¹ (mmhos cm⁻¹).
 7. Moisture Content – 30%-65% (dry weight basis), 30%-65% (wet weight basis).

8. Maturity – The compost shall be resistant to further decomposition and free of compounds, such as ammonia and organic acids in concentrations toxic to human health or plant growth.
 - a. Seed Emergence and Seedling Vigor: Minimum 80% relative to positive control.
 9. Residual Seeds & Pathogens – Pathogens and noxious seeds shall be minimized.
 10. Biological Contaminants – Compost shall not contain any pathogenic material and shall meet or exceed the US EPA Class A standard, 40 CFR 503.32(a) levels on a MPN per gram per dry weight basis.
 11. Chemical Contaminants – Compost shall not contain any chemical contaminants and shall meet or exceed the US EPA Class A standard, 40 CFR 503.13, Tables 1 & 3 levels on a ppm basis.
 12. Stability – less than 8 mg CO₂C per g OM per day evolution rate.
- B. Provide laboratory analysis for particle size, percent organic matter, maturity of the compost, and testing for bacterial contamination (salmonella and/or fecal coliform at a minimum) and a description of the source and list of the specific organic materials utilized to make the compost. Submit the results for review and approval prior to delivery or installation on-site.

2.04 MISCELLANEOUS SOIL AMENDMENTS

- A. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or granular texture, with a pH range of 3.4 to 4.8. Provide only as necessary to adjust for pH imbalances.
- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve. Provide only as necessary to adjust for pH imbalances.
- C. Lime: Ground dolomitic limestone conforming to ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent. Provide only as necessary to adjust for pH imbalances.
 1. Provide lime in form of ground dolomitic limestone, if required.

2.05 PLANTING SOIL FOR PLANT BEDS

- A. Planting Soil: Plan to mix topsoil and amendments conforming to the requirements of this section in the following ratio to produce planting soil (final ratios to be determined after review of topsoil test results):
 1. 6-parts topsoil tested and approved for use on the project.
 2. 1-part sand, approved for use on the project
 3. 1-part compost, approved for use on the project
 4. Other amendments (lime, sulfur, peat moss, additional compost, additional sand, etc.) as recommended by the soil test results and/or to adjust pH.
 5. Fertilizer of composition and rate as recommended by soil testing laboratory results.
- B. Final planting soil ratios are subject to review and revision by the Landscape Architect based on soil testing results and will be required to be provided at no additional cost to the project.
- C. Thoroughly blend planting soil off-site before spreading.

2.06 ENGINEERED SOILS FOR BIOFILTRATION BASINS

1. Refer to Civil Engineer's plans, plan notes, and details for information related to engineered soil composition, standards and construction of biofiltration areas.

2.07 WATER

- A. Supply potable water for consolidating the modified soil layer. In lieu of potable water, supply clean, clear water, free from harmful contaminants, from a source approved by the Landscape Architect. Contractor will be required to provide their own supplemental water source and delivery method (i.e., water trucks) and/or will be required to coordinate supply from the project site and reimburse the City of Madison for all utility charges associated with water used during construction and landscape maintenance activities.

2.08 FERTILIZERS, HERBICIDES AND PESTICIDES

- A. Granular, non-burning product composed of not less than fifty (50) percent organic slow-acting, guaranteed analysis professional fertilizer. Commercial fertilizer shall meet the standards of the Wisconsin Department of Agriculture as to registration and labeling. Fertilizer composition shall be guided by recommendations set forth by soil test results.
 - 1. All fertilizers shall be delivered fully labeled according to applicable regulations, bearing name, trade name, or trademark of producer, along with the producer's warranty.
 - 2. Application amounts of fertilizer and fertilizer composition will be governed by the recommendations of the independent testing firm's soil test(s).
- B. Supply and apply a non-selective herbicides to treat all annual and perennial weeds that germinate on the existing topsoil stockpile that is within the project site and intended to be used on the project.
- C. Pesticide application shall be done in accordance with all applicable ordinances and regulations and only as approved by the City's Project Representative.

PART 3 EXECUTION

3.01 TOPSOIL STOCKPILE TREATMENT

- A. The Contractor shall continuously monitor any/all topsoil stockpiles located on the project site for weed germination and growth and utilize hand-removal (including root) or selective chemical herbicides to control weeds. Weed control and monitoring shall commence immediately upon mobilization to the project site and shall continue through the duration of construction at regular intervals whenever weed seedlings begin to appear and up until 10-days prior to blending or spreading stockpiled topsoil.
- B. Contractor will be responsible for monitoring the stockpile weekly for presence of germinating weeds and treat the stockpile for weeds on 10-day cycles.
- C. All herbicide applications shall be done by a licensed, trained professional and in accordance with the herbicide manufacturer's written instructions and all applicable codes and ordinances and applied with extra-ordinary care so as not to runoff or overspray into environmentally sensitive areas of the site.
- D. Herbicide treatments shall only occur when existing and forecasted weather conditions permit robust application without overspray, drifting, blowing or forecasted rain events that would create washout or leeching.
- E. Contractor shall securely contain the perimeter of the topsoil stockpile if stockpile is not already completely contained within the project's secured perimeter construction fencing to prevent access by non-Contractor community members and post signage around the perimeter of the topsoil stockpile before, during and after each herbicide application stating that treatment has occurred, the date of treatment, the chemical applied, and a contact phone number for the Contractor or herbicide applicator.
- F. Contractor shall maintain a Treatment Log including the name of the project, project number, the date of each treatment, type of treatment (hand pulling vs chemical), chemical used, and name and contact information of applicator or maintenance personnel. The completed Treatment Log shall be included in the final O&M documentation for the project.

3.02 SOIL PREPARATION SCHEDULE OF REVIEWS

- A. The Contractor shall create a single-page, typewritten Soil Preparation Review Log including the name of the project, project number, the review schedule milestones, a line for dates completed and a line for signatures by the Contractor's trained personnel or subcontractor(s). The completed Log shall be included in the final O&M documentation for the project.
- B. Milestones shall include:
 - 1. After subgrades have been prepared and prior to placement of soil materials.
 - 2. After continuous treatment of topsoil stockpile for weed germination and growth and prior to moving stockpiled material to any portion of the site or blending with amendments for installation.

3. After soil material placement and final fine grading and prior to any seeding or planting.
4. At any other point specified by the A/E or the City's Project Representative.

3.03 GENERAL SUBGRADE PREPARATION

- A. Subgrades are those grades present on-site during construction and refers specifically to the soil surface exposed by excavating (in a cut situation) or existing surface grades present before earthmoving operations (in a fill situation).
- B. Excavate areas to be planted or seeded and remove all construction debris, concrete slag piles, etc. Take care not to undermine adjacent pavements.
- C. Remove all vegetation carefully with selective herbicides from subgrades that have been exposed to open-air conditions during construction. Remove all rocks, debris, and litter from subgrades that will prevent compliance with this section and other sections of the Contract.
- D. Compacted subgrades shall be excavated as necessary to provide the depths of Soil Materials indicated in this section and in coordination with the Civil Engineer's grading plan. The Civil Engineer's grading plan indicates final surface grades of Soil Materials and depths indicated in this Section represent final proposal depths after settling has occurred. Contractor shall account for settling when determining quantities of each material to be placed over prepared subgrades.
- E. Prepare subgrades by ripping, fracturing, tilling or discing the subsoil to a minimum depth of 6" to 8" to allow aeration. Remove all stones, clay clods or other masses greater than 6" that rise to the surface during subsoil decompaction operations.
- F. Contractor shall examine all prepared subgrades prior to the delivery or installation of Soil Materials for all detrimental conditions including compaction, contamination by deleterious materials, presence of large construction debris, poor drainage, and/or any other negative conditions. Contractor shall notify General Contractor and Landscape Architect of all subsoil preparation inadequacies immediately and Soil Materials shall not be placed until all subsoil deficiencies have been corrected. Contractor will be held responsible for negative results from improper subsoil preparation if Soil Materials are placed with disregard to inadequately prepared subgrades.
- G. For Biofiltration Areas: Refer to Civil Engineer's plans, plan notes, and details for biofiltration area soils and materials, preparation for construction, excavation, installation materials and methods, and protection of these areas during construction. Refer to Section 32 93 00 "Plants" for planting and surfacing for biofiltration basins.
- H. The Landscape Architect has the option to review subsoil characteristics and quality with the General Contractor, Earthwork Contractor and/or Landscape Contractor and modify subgrade preparation requirements in the field, as necessary, based on existing field conditions.
- I. Excavate compacted construction subgrades to the following minimum depths:
 1. Seeded and/or Sodded Lawns: 8 inches
 2. Native seed plantings: 12 inches
 3. Planting Beds: 18 inches
 4. Tree Plantings: Match the depth of tree root ball or 24", whichever is greater
- J. All subgrade areas shall be graded to a smooth uniform surface plane with loose, uniformly fine texture; rolled and raked to remove ridges and fill depressions; and ready for final topsoil or planting soil application. Areas shall be restored if eroded or otherwise disturbed after grading.

3.04 PLACING SOIL MATERIALS

- A. Soil Materials refers to either Topsoil or Planting Mixture for at-grade installations.
- B. Contractor shall account for settling when determining amounts of Soil Materials required to meet proposed site grades and spot elevations; depths indicated in this Section represent final proposed depths after settling has occurred.
- C. Do not apply Soil Materials to saturated or frozen subgrades.

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- D. Compost and/or other amendments must be pre-blended into topsoil off-site prior to placement in lawn areas if initial soil tests indicate low organic matter content of the topsoil intended to be used; compost will be considered incidental to the topsoil. The Contractor may also choose to find a different source for topsoil which meets the requirements of this section without the addition of compost.
 - E. Install Soil Materials in 6-inch lifts. After the first lift is installed in all areas, Contractor shall work Soil Materials into top 2 to 4 inches of decompacted subgrades to blend. Any additional Soil Materials shall be installed in subsequent lifts of no more than 6 inches.
 - F. Install Soil Materials to the following depths over prepared, decompacted subsoils:
 - 1. Topsoil for Lawns: 8" above prepared site subgrades for all areas to receive bluegrass seed materials as indicated in Working Drawings.
 - 2. Topsoil for Trees in Lawns: 18-24" above prepared site subgrades for trees planted in lawn areas; depths based on rootball depth for each individual tree.
 - 3. Planting Soil for Plant Beds: 18" above prepared site subgrades for all at-grade planting beds.
 - 4. Planting Soil for Trees in Planting Beds: 18-24" above prepared site subgrades for all at-grade planting beds; depths based on rootball depth for each individual tree.
 - G. Place and spread the specified planting soil to the correct depths adjusting for the difference between seed, sod or planting bed finished grade so that landscape surfaces are level and appear seamless between adjacent surfaces (i.e., bluegrass lawn to native seeded area or bluegrass lawn to planting bed, etc.).
 - H. Do not apply topsoil to saturated or frozen subgrades.
 - I. Stockpile any additional Soil Materials, separately to prevent contamination of one type to another and/or to other bulk materials on-site, for fine grading operations, to repair areas which may settle, and/or to backfill planting holes if additional Soil Materials are needed.
 - J. Areas shall be graded to a smooth uniform surface plane with loose, uniformly fine texture. All areas shall be rolled and raked to remove ridges and fill depressions and ready for planting or sodding. Areas shall be restored if eroded or otherwise disturbed after grading.
 - K. For Biofiltration Areas: Refer to Civil Engineer's plans, plan notes, and details for biofiltration area soils and materials, preparation for construction, excavation, installation materials and methods, and protection of these areas during construction. Refer to Section 32 93 00 "Plants" for planting and surfacing for biofiltration basins.

3.05 FERTILIZER

- A. Fertilizer shall be applied only as recommended by the soil tests and as directed by the Landscape Architect. If utilized on the project, fertilizer shall be blended into the entire depth of Topsoil during decompaction and spreading operations.

END OF SECTION

SECTION 32 92 19 SEEDING

PART 1 GENERAL

1.01 DESCRIPTION

- A. Treatment for weeds, installation of seeded bluegrass and native lawns, erosion control materials for seeded areas, Contractor-required maintenance, and satisfactory installation of seeded lawns.

1.02 RELATED WORK AND REQUIREMENTS

- A. Applicable provisions of Division 01 shall govern Work of this Section.
- B. Section 01 57 13 - Temporary Erosion and Sediment Control: for coordination of site and landscape installation work with ongoing erosion control measures.
- C. Section 31 22 00 - Grading: for coordination with excavation and subgrade preparation work.
- D. Section 32 14 13.13 - Miscellaneous Landscape Surfaces: for coordination with aggregate paths and installations.
- E. Section 32 91 13 - Soil Preparation: for at-grade soil quality, testing requirements, and depths.
- F. Section 32 92 23 - Sodding: for coordination with sodding.
- G. Section 32 93 00 - Plants: for coordination with planting and landscape materials and installations.

1.03 REFERENCES

- A. State of Wisconsin, Department of Transportation, Standard Specifications for Highway and Structures Construction (WisDOT SSHSC). Current edition.
- B. City of Madison Standard Specifications for Public Works Construction, Article 207 "Seeding". Current edition.

1.04 SUBMITTALS

- A. Product Data for Pesticides, Herbicides and/or Fertilizers: Include product label and manufacturer's application instructions specific to this Project.
- B. Certification of Seed for Bluegrass Seed Lawn Mix: From seed vendor showing seed mix composition and a guarantee of germination and the following information:
 - 1. Scientific name of genus and species (subspecies and varieties, as necessary) for each species.
 - 2. Calendar year in which seed was collected.
 - 3. Seed origin.
 - 4. Proposed seeding rate.
- C. Certification of Seed for Native Mixes: From seed vendor showing seed mix composition and a guarantee of germination and the following information and/or guarantees:
 - 1. Scientific name of genus and species (subspecies and varieties, as necessary) and guarantee that seeds are true to species.
 - 2. Bulk weight of seed.
 - 3. Pure Live Seed (PLS)
 - 4. Supplier lot identification.
 - 5. Calendar year in which seed was collected.
 - 6. Seed origin (geographical location).
 - 7. Seed supplier contact information including company name, address, phone number, contact person's name and e-mail address
- D. Qualification Data: For qualified Landscape Installer whose work has resulted in successful short and long-term establishment and maintenance of and bluegrass lawns and native vegetation from seed.
- E. Warranty: All seeded areas shall be under warranty for 12 months from the date of substantial completion. Submit Contractor's stated typewritten warranty on letterhead.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified Landscape Installer whose work has resulted in successful establishment of bluegrass lawns and native turf areas from seed.
 - 1. Installer's Field Supervision: Installer is always required to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 2. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
 - 3. Pesticide Applicator: State licensed, commercial.
- B. Site-Wide Weed Control: Contractor shall continuously work to identify the presence of specific broadleaf weed or aggressive or invasive species and control of both annual and perennial weeds for the entire project site from the time of contract award to the time of final turfs and grasses installation and establishment, through the end of the maintenance and warranty period. The Contractor shall periodically visit the site at various times during the growing season, even prior to turfs and grasses installation, to update evaluations and treatment recommendations and to tailor the specific management plans to the anticipated dates of landscape installation; visits shall continue through the duration of the maintenance period.
- C. Preinstallation Conference: Conduct conference at Project site with City's Project Representative, Installer's Supervisor, Plants Installation Contractor (if separate entity from turfs and grasses contractor), and any other Contractors or City's Representatives present.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged seed materials in original, unopened containers labeled as to name and address of supplier; specific blend of seed; weed an inert material content; and indication of conformance with state and federal laws, as applicable. Store any seed delivered prior to use in a manner safe from damage from heat, moisture, rodents, or other causes of degradation. Any damaged seed damaged shall be replaced by the Contractor at no additional cost to the project.
- B. Deliver any additional packaged materials in original, unopened containers labeled as to contents, name and address of manufacturer, and indication of conformance with State and Federal laws, if applicable.
- C. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
- D. Provide additional temporary erosion-control measures as necessary to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems or walkways.
- E. Accompany each delivery of non-seed bulk materials with appropriate certificates.

1.07 PROJECT CONDITIONS

- A. Planting Restrictions for Bluegrass Seeding: Seed during one of the following periods. Coordinate with other seeding operations and initial maintenance periods to provide required maintenance from date of planting completion.
 - 1. Spring Seeding Season: April 1 to June 15.
 - 2. Fall Seeding Season: August 15 to October 1.
- B. Planting Restrictions for Native Seed Mixes: Seed during one of the following periods. Coordinate with other seeding operations and initial maintenance periods to provide required maintenance from date of planting completion.
 - 1. Regular Seeding Season: May 1 to June 15.
 - 2. Dormant (fall) Seeding: October 30 to snowfall.
 - 3. Frost seeding is an option that can be utilized in consultation with Contractor, Native Seed Supplier, Landscape Architect, and/or City's Project Representative if construction schedule results in late-season installation timing.

- C. Do not install seed when the air temperature is above 95 deg. F or below 40 deg. F or onto frozen soil materials.
- D. Weather Limitations: Proceed with installations only when existing and forecasted weather conditions permit installations to be performed when beneficial and optimum results may be obtained. Apply all materials during favorable weather conditions according to manufacturer's written instructions and/or grower's instructions.
- E. Site Restoration and Soil Stabilization: Contractor shall coordinate with General Contractor to establish permanent vegetative cover for the entire project in the same growing season as earthmoving operations. If ongoing earthmoving and earthwork is anticipated in the following season, final vegetation restoration shall be delayed until all earthwork is completed and the entire site shall be stabilized with an annual cover crop or other approved means before the end of the construction season and no later than October 15 of any given year to ensure the project continues to meet all applicable erosion control permit requirements and that open soils over winter do not create erosion problems or violate permits.

1.08 MAINTENANCE AND WARRANTY

- A. Maintenance and Warranty: Maintenance and warranty of the installation is considered part of the contract. Compliance with the requirements herein is mandatory. In the event of question or dispute over applicability of any requirement, the requirement shall be assumed to apply, unless the Landscape Architect provides written clarification stating that it does not.
- B. Maintenance shall begin as soon as each individual area is installed and continue through the duration of seeding installation for the whole project. At the time of seeding completion, as determined by the Landscape Architect, the project's actual maintenance period will begin.
- C. Warranty: Installer agrees to warrant that healthy, vigorous and close stands of weed and pest free seeded areas are on a successful path to establishment at the end of the warranty period under the condition that the City has maintained the seeded areas in conformance with this Section after the Contractor's required maintenance period expires. Installer agrees to repair or replace seeded areas and accessories that fail in materials, workmanship or growth at any time during the warranty period, using new materials. Seeded areas that fail in materials, workmanship, or growth within specified warranty period must be repaired or replaced by the Contractor at no additional cost to the project.
 - 1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse or incidents that are beyond Contractor's control.
 - b. Areas of pest infestation.
 - c. Areas of subsidence or washout.
 - d. Lack of germination of seed material.
 - e. Excessive weed growth.
 - 2. Include the following remedial actions as a minimum:
 - a. Immediately repair areas that have been washed out, subsided, damaged, or disturbed by replacing soil with the appropriate Soil Material conforming to Section 32 91 13, "Soil Preparation", re-securing any and all erosion control materials, and/or re-establishing the surface cover with the same materials used in the original installation, including new erosion control materials as necessary.
 - 3. Maintenance Period from Date of Seeding Completion: 12 months.
 - 4. Warranty Period from Date of Seeding Completion: 12 months.
- D. Maintenance: Provide full maintenance by skilled employees of Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is installed and continue to maintain through the duration of seeding operations and for no less than the stated Contractor maintenance period.
- E. The contractor shall use appropriate means, methods and materials available to them to fulfill the requirements of the Contract, maximize the germination potential of any seeded areas and ensure the successful establishment of viable, healthy lawns via accepted industry standards.

- F. The contractor shall examine installed areas throughout the growing season following the installation for germination and/or growth and shall determine, in coordination with the City's Project Representative that all areas are on a successful path to establishment. In addition to regularly scheduled maintenance visits, the contractor shall make investigative site visits throughout the maintenance period a minimum of three times to assess invasives and to observe and report on establishment of species and shall provide these written reports to the City's Project Representative in a digital word document format.

1.09 COORDINATION

- A. Contractor shall coordinate all installation operations with other contractors working on site. Contractor shall coordinate specifically with landscape contractor(s) responsible for performing planting, sodding, landscape surfaces and stonework, and site furnishings installation operations (if separate contractor or crew from seeding installer) and/or other contractors performing site stabilization operations to eliminate conflicts in scheduling, materials storage, maintenance, and/or other coordination.

PART 2 PRODUCTS

2.01 BLUEGRASS LAWN SEED MIX

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.
- B. Grass Seed Mix Basis of Design:
1. Bluegrass Blend of the following composition (based on Madison Parks Blend by LaCrosse Seed, <https://www.lacrosseseed.com>):
 - a. 50% Kentucky Bluegrass (3-4 elite varieties)
 - b. 25% Creeping Red Fescue (1 elite variety)
 - c. 25% Ryegrass (1-2 elite varieties)
 2. Submit composition of seed mix including bluegrass varieties and percent per variety; additional species of grass in mix and percent per species; proposed seeding rate; seed supplier contact information including name, address, phone, and e-mail address.

2.02 NATIVE SEED MIXES

- A. Provide seed of species and varieties, proportions by seed count, and minimum percentages of purity, germination and maximum percentage of weed seed as indicated below.
- B. Species composed of pure live seed (PLS) shall contain no named or improved varieties. PLS shall be from Iowa, Wisconsin, Northern Illinois, or Western Minnesota nurseries specializing in growing native species from Wisconsin genotypes.
- C. All seed shall be cold, dry stratified; legumes shall be scarified and inoculated with proper rhizobia immediately prior to planting (three hours or less). Legumes shall be kept out of the forbs mixture until after inoculation. Seed mixture shall be blended by the vendor and ratios of various species shall be guaranteed by the seed vendor in writing as specified. Minimum percent purity for native species is 96 percent. Any substitutions of species due to availability must be approved by Landscape Architect.
- D. NATIVE SEED-01: "Low-Growing Meadow for Dry Soils" native seed mix by Prairie Nursery (www.prairienursery.com) , or approved equal, for use on areas indicated in Working Drawings.
- E. NATIVE SEED-02: "Diverse Prairie for Dry Soils" native seed mix by Prairie Nursery (www.prairienursery.com) , or approved equal, for use on areas indicated in Working Drawings.
- F. NATIVE SEED-03: "Woodland Edge – Savannas for Medium Soils" native seed mix by Prairie Nursery (www.prairienursery.com) , or approved equal, for use on areas indicated in Working Drawings

2.03 LANDSCAPE EDGINGS

- A. Spaded Edging: Contractor shall provide a spaded edge without backfill material (i.e. no bark mulch fill) along the entire perimeter for all sodded areas abutting native seeded or plugged areas.

2.04 ANNUAL COVER CROP FOR NATIVE SEEDED AREAS

- A. Cover Crop Mix: The final blend of species and percentages of each for the annual cover crop shall be provided, in writing, in consultation between the seed supplier and installation contractor (if separate entities) stating percentages of each seed by species (not weight). Cover crop is considered incidental to the native seed mixes. Submit mix to Landscape Architect for final approval.
1. (Avena sativa)
 2. (Lolium multiflorum)

2.05 WINTER COVER CROP FOR EXPOSED SOILS

- A. Cover Crop Mix: The use and application of winter wheat or other winter cover crop shall only be used as a temporary site stabilization measure based on overall project construction timing and sequencing and must be justified, in writing, to the Landscape Architect stating the installation methodology, seeding rate, maintenance, and removal after use as erosion control cover crop. The Contractor shall obtain approval from the Landscape Architect before using a winter cover crop on exposed soils.
1. (Triticum aestivum)

2.06 WATER

- A. Supply potable water during seeding installation and maintenance. In lieu of potable water, supply clean, clear water, free from harmful contaminants, from a source approved by the Landscape Architect. Contractor will be required to provide their own supplemental water source and delivery method (i.e., water trucks) and/or will be required to coordinate supply from the project site and reimburse the City of Madison for all utility charges associated with water used during construction and landscape maintenance activities.

2.07 SOIL MATERIALS

- A. Topsoil shall be provided for any repairs based on Specification Section 32 91 13 "Soil Preparation".

2.08 STARTER FERTILIZER FOR BLUEGRASS LAWN AREAS

- A. Fertilizer designed for establishment of newly seeded bluegrass lawns only.
- B. Scotts® Starter® Fertilizer by the Scotts Miracle-Gro Company or approved equal.

2.09 PESTICIDES AND HERBICIDES

- A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.10 EROSION-CONTROL MATERIALS

- A. Erosion Control Materials for Native Seeded Areas:
1. Provide Curlex II erosion control blanket by American Excelsior (www.americanexcelsior.com or 1-800-777-7645) or approved equal for all native seeded areas where slopes exceed 4:1.
 2. Provide Curlex 'Net Free' erosion control blanket by American Excelsior (www.americanexcelsior.com or 1-800-777-7645), or approved equal for all native seeded areas where slopes are less than or equal to 4:1.
 3. Provide manufacturer's recommended biodegradable erosion control stakes, 6-inches in length, for all native seeded areas to receive erosion control blankets.
- B. Erosion Control Materials for Bluegrass Seeded Areas:

1. Provide Urban Class I Type B straw-filled erosion control blanket (mat) with jute fiber top and bottom net in accordance with the WisDOT PAL for SSHSC Section 628 – Erosion Control for areas to be seeded with bluegrass lawn only.
 2. Provide metal anchors.
- C. Straw for Small Areas of Seeding Repair: Provide clean weed-free chopped straw mulch for all seeded areas less than 3' x 3' in area and only to repair small sections of damaged seeded area; if damaged areas are larger than 3' x 3', contractor shall patch in and secure erosion control blanket.

PART 3 EXECUTION

3.01 TREATMENT OF NOXIOUS WEEDS

- A. The Contractor shall continuously monitor the site for weed germination and growth and utilize hand-removal (including root) or chemical herbicides to control weeds. Weed control and monitoring shall commence immediately upon mobilization to the project site and shall continue through the duration of construction at regular intervals whenever weed seedlings begin to appear.
1. Contractor will be responsible for monitoring for presence of germinating weeds and treating the site on 10-day cycles.
 2. All herbicide applications shall be done by a licensed, trained professional and in accordance with the herbicide manufacturer's written instructions and all applicable codes and ordinances.
 3. Herbicide treatments shall only occur when existing and forecasted weather conditions permit effective application without overspray, drifting, blowing or forecasted rain events that would create washout or leeching.
 4. Contractor shall post signage around the perimeter of the treated area before, during and after each herbicide application stating that treatment has occurred, the date of treatment, the chemical applied, and a contact phone number for the Contractor or herbicide applicator.
 5. Contractor shall maintain a Treatment Log including the name of the project, project number, the date of each treatment, type of treatment (hand pulling vs chemical), chemical used, and name and contact information of applicator. The completed Treatment Log shall be included in the final O&M documentation for the project.

3.02 SEEDING SCHEDULE OF REVIEWS

- A. The Contractor shall create a single-page, typewritten Seeding Review and Log including the name of the project, project number, the review schedule milestones, a line for dates completed and a line for signatures by the Contractor's Representative and A/E. The completed Log shall be included in the final O&M documentation for the project.
- B. Milestones shall include:
1. After topsoil placement and final fine grading and prior to any seeding.
 2. After seeding and erosion control materials have been installed.
 3. 10-day intervals after seeding and erosion control to monitor the germination of all seeded areas and/or presence of noxious annual weeds for the first 60 days.
 4. Refer to Maintenance section for additional maintenance log requirements.

3.03 EXAMINATION

- A. Examine areas for compliance with requirements and other conditions affecting performance.
1. It is the responsibility of the Contractor to verify that sufficient Soil Materials have been provided both in terms of quality and quantity (depths) as indicated in Section 32 91 13, "Soil Preparation" and that subgrades have been properly decompacted. If insufficiencies in soil materials or subgrade preparation occur, Contractor shall notify an City's Project Representative immediately and shall not begin any installation operations until any and all unsatisfactory conditions have been corrected.
 2. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within installation areas.
 3. Uniformly moisten excessively dry soil that is not workable, and which is too dusty.

- B. If contamination by foreign deleterious material or liquid is present in soil within an area to be installed, remove the entire extent of the contaminated soil as directed by the City's Project Representative and replace with new soil material.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.04 PREPARATION, GENERAL

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by installation operations.
 - 1. Protect adjacent and adjoining areas from seeding operations.
 - 2. Protect grade stakes set by others until directed to remove them.
- B. Install any temporary erosion-control measures as necessary to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways during installation operations.
- C. Limit preparation to areas to be immediately seeded. Continuous evaluation and remove any and all undesirable vegetation that has germinated in the areas to be seeded is considered part of the project requirements. The General Contractor shall have a restoration ecologist evaluate the use of herbicides based on site conditions including the presence of specific broadleaf weed species for the optimum control of invasives. The use of methods other than glyphosate is preferred.
 - 1. Limit preparation to areas to be immediately seeded. Continuous evaluation and remove any and all undesirable vegetation that has germinated in the areas to be seeded is considered part of the project requirements. The General Contractor shall have a restoration ecologist evaluate the use of herbicides based on site conditions including the presence of specific broadleaf weed species for the optimum control of invasives. The use of methods other than glyphosate is preferred.
- D. If a Project Representative determines that glyphosate treatment should be part of initial preparation based on specific site conditions, the following conditions shall be met, at a minimum:
 - 1. Herbicide should be applied when weeds are green and actively growing. Do not apply before or after growing season.
 - 2. Continuous, frequent weed control is required.
 - 3. Final treatment shall be performed in conjunction with anticipated date of seeding installation such that residual herbicides do not affect seed or plant germination, growth or development. Landscape Contractor shall be in close contact with General Contractor and the GC's restoration ecologist to ensure coordinated timing, effort and proper weed control of the site at all times.
 - 4. The A/E reserves the right to delay installation until aggressive weeds are controlled which may require additional mowings and herbicide treatments.
 - 5. Do not apply seed until five to seven days after last herbicide treatment and as recommended by the specific seed supplier and in consultation with the GC's restoration ecologist.
 - 6. Ensure that any herbicides used are compatible with and approved for use in the specific application area i.e., near an open waterway.
- E. Confirm topsoil has been provided per Section 32 91 13 "Soil Preparation" in the areas and depths indicated by the written specifications. If unsuitable topsoil conditions or depths exist, notify the A/E immediately and do not proceed with seeding operations until any and all unsatisfactory conditions have been corrected.
- F. Finish Grading: Grade areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be immediately seeded and stabilized with erosion control materials.
- G. Moisten prepared area before seeding if soil is dry. Water thoroughly and allow surface to dry before seeding. Do not create muddy soil.

- H. Before seeding, obtain acceptance by A/E of finish grading; restore seeding areas if eroded or otherwise disturbed after finish grading.
- I. No seeding shall occur on frozen ground or at temperatures lower than 32 deg. F.

3.05 SOWING BLUEGRASS LAWNS

- A. Installation contractor, in consultation with seed supplier, shall propose recommended rates of application to ensure establishment of healthy, viable, vigorous stand of bluegrass lawn.
- B. Sow seed at rates indicated by seed supplier for timing of seeding and seasonal conditions. Application rate shall be based on broadcast method of application and shall be submitted to the A/E for approval in advance of ordering seed or installing seed. Application rate should be the maximum rate to achieve a vigorous, healthy stand of each type of seed with the maximum coverage in the shortest period of time.
- C. Do not use wet seed or seed that is moldy or otherwise damaged. Sow seed in accordance with seed supplier's written instructions with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing half of the seed in one direction and the other half in the opposite direction at a right angle to the first direction.
- D. Lightly rake or drag to cover the seed with approximately ¼-inch to ½-inch of topsoil, lightly roll or rake the areas using suitable equipment.
- E. Immediately install and secure erosion control materials to form a continuous surface cover for all seeded areas, properly installed and secured in place.
- F. Provide a spaded edge without backfill material (i.e. no bark mulch fill) along the entire perimeter for all areas of bluegrass lawn abutting native seeded or plugged areas.
- G. Water with a fine spray to evenly moisten mulch and top ½ inch of soil. Do not overwater or create muddy or puddle conditions. Contractor may have to water in increments to reduce changes of puddling, ponding, and/or erosion.
- H. Contractor will be responsible for providing a finished product that meets or exceeds all applicable erosion control requirements and standards.

3.06 SOWING NATIVE SEEDED AREAS

- A. Sow the native seed mixture with a rangeline type drill with one or more seed boxes that can be calibrated independently to deliver different sized seeds uniformly at the required rate equipped with area-mounted press wheel for each seed drop tube or by scattering uniformly over the areas to be seeded. If the configuration of the area to be seeded allows, apply at ½ the specified seed rate in one direction and apply the second ½ in a perpendicular direction. For hand broadcast seeding of small or inaccessible areas lightly rake or drag to cover the seed with approximately ¼ inch of topsoil or compost mulch, lightly roll or rake the areas using suitable equipment. The contractor shall use cultipacker type equipment if the seedbed is too loose or if the seedbed contains clods that might reduce seed germination. The contractor shall not roll slopes steeper than 1:3.
- B. If cover crop is included, the Contractor shall consult with the seed supplier to determine whether to mix cover crop and native seed and install at the same time or whether to install one seed type and then install the other seed type, calibrated and installed separately into the same area(s).
- C. Rate for sowing seeds shall be based on seed size of selected species (given in seeds per square foot) and shall be calculated by a restoration ecologist using a spreadsheet, which shall be made available to the A/E.
- D. If annual cover crop is being installed as part of prairie installation, mix cover crop into seed mix and/or calibrate independently and install at the same time as the prairie seed. Sow annual cover crops at rates indicated by seed supplier for timing of seeding and seasonal conditions. Application rate should be the maximum rate to achieve a vigorous, healthy stand of cover crop with the maximum coverage in the shortest period of time.

- E. Immediately install and secure erosion control materials to form a continuous surface cover for all seeded areas, properly installed and secured in place.
- F. Provide a spaded edge without backfill material (i.e. no bark mulch fill) along the entire perimeter for all areas of native seed abutting bluegrass laws (seeded or sodded).
- G. Water with a fine spray to evenly moisten mulch and top ½ inch of soil. Do not overwater or create muddy or puddle conditions. Contractor may have to water in increments to reduce changes of puddling, ponding, and/or erosion.
- H. Contractor will be responsible for providing a finished product that meets or exceeds all applicable erosion control requirements and standards.

3.07 PREPARATION AND INSTALLATION OF EROSION-CONTROL MATERIALS

- A. Provide erosion control materials for all seeded areas. Refer to product type, this Section, for which type of erosion control material to install based on slopes and type of seed (bluegrass vs native seed).
- B. Do not install any erosion control materials in areas to be sodded with bluegrass sod or in planting beds or in biofiltration areas; install in seeded areas only unless otherwise indicated in project drawings.
- C. Install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer with biodegradable or metal stakes (see Products for type of stake to use with each type of mat or blanket).
- D. Provide thick, generous layer of chopped straw mulch for repair lawn areas only that are less than 3' x 3'; properly crimp into top surface of the soil to ensure that straw stays in place. For repair areas larger than 3' x 3', Contractor shall patch in erosion control blanket that is slightly larger than the area to be patch such that it overlaps with in-place erosion control blanket (type to be determined by slope) as specified in this Section, anchoring with extra anchors to ensure the blanket patch stays in-place. Straw mulch displaced by wind or water or other means will need to be re-installed until a vigorous, healthy stand of turf is established.

3.08 TURF REPAIR AT CONSTRUCTION BOUNDARY

- A. Repair any existing areas of turf or grasses greater than 6" x 6" damaged or disturbed by construction operations at the boundary of the work area. Preparation and installation methods and materials for repairs shall be consistent with this Section.
- B. Examine area to be repaired for any unsatisfactory conditions; correct any unsatisfactory conditions before proceeding with repair.
- C. Provide additional topsoil for any areas where washout, rutting, divets, or any other unsatisfactory soil surface conditions occur.
- D. Loosely scarify soil if compaction has occurred in bare spot.
- E. Install seed in accordance with the procedures and practices outlined in this Section. Provide crimped straw mulch for small areas of repair; provide erosion control materials conforming to the materials in this Section for larger (larger than 3' x 3') areas of repair.
- F. Water newly installed areas and keep moist until new seed is established.

3.09 CLEANING AND REPAIR

- A. Waste and excess material from the installation operations shall be promptly removed. Adjacent paved areas are to be cleaned, and any damage to existing adjacent turf areas, planting areas, or other features shall be repaired.
- B. Erect temporary fencing or barricade warning signs as required to protect newly installed areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove only after the installations are established.

3.10 MAINTENANCE OF BLUEGRASS LAWNS

- A. Begin maintenance immediately after seeding and continue until the end of the specified maintenance period.
- B. Maintain and establish bluegrass turf by watering, fertilizing, weeding, mowing, removing trash or debris, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, re-grade, and replant bare or eroded areas to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
 - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
 - 2. In areas where erosion control materials or straw mulch has been disturbed by wind or maintenance operations, add new mulch or erosion control materials and anchor as required to prevent displacement.
 - 3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- C. Watering: Seeded areas are to be watered daily to maintain adequate soil surface moisture for proper seed germination. Watering shall continue for not less than 30 days following seeding. Thereafter, apply $\frac{1}{2}$ " of water twice weekly until final acceptance.
 - 1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
- D. Mowing: Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than $\frac{1}{3}$ of grass height. Remove no more than $\frac{1}{3}$ of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
 - 1. Mow lawn to a height of 2-1/2 inches before June and after September and no less than 3" from June through September.
 - 2. Mowing operations include trimming around obstacles and raking of excess grass clippings. String trimmers shall not be used around trees or shrubs.
 - 3. Any plant material damaged at any time during turfgrass maintenance shall be replaced at the original size and species at no cost to the project.
- E. Turf Postfertilization: Apply fertilizer after initial mowing and when grass is dry if results of soil test confirm the need for fertilizers and within compliance with local ordinances. Use fertilizer that will provide actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.
- F. Herbicide Treatments: During the maintenance period, selectively spot treat all seeded areas with selective, non-persistent glyphosate-based herbicide to manage specific annual and/or perennial aggressive weeds that germinate. Specific herbicides shall be based on target invasive species and shall not hinder growth or kill turf species. Treat only on cool, windless days preferably by gloved hand wiping method or with a backpack sprayer and properly-fitted nozzle. Follow all label directions for use, application, and safety. Coordinate applications with the City's operations and others in proximity to the Work. Notify the City before each application is performed
- G. Erosion Control Stake Removal: At the end of the maintenance period, assuming a healthy and vigorous stand of turf has been established, Contractor shall use metal detector to locate and hand-remove any metal stakes from the project site and dispose of properly at no additional cost to the project.

3.11 MAINTENANCE OF NATIVE SEEDED LAWNS

- A. Begin maintenance immediately after seeding and continue maintenance through the rest of installation and until substantial completion of the seeding and landscape has been obtained. The date of substantial completion for seeding and landscape installation will constitute the start of the official maintenance period for the project. The Contractor performing the maintenance of seeded areas shall prepare a Maintenance Log template that includes the name of the project, project number, date of maintenance, personnel performing the maintenance, a list of maintenance activities performed, and notes on the presence of any conditions affecting the short or long-term viability of seeded areas and the corrective measures taken to fix these conditions.
- B. Maintain and establish by weeding, watering, mowing, trimming, overseeding, and performing other operations as required to establish a healthy, viable native seeded area. Roll, re-grade, and replant bare or eroded areas and re-install erosion control materials. Provide materials and installation the same as those used in the original installation.
 - 1. Contractor responsible for seeding shall coordinate with General Contractor to fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and seeded areas damaged or lost in areas of subsidence.
 - 2. In areas where erosion control materials have been disturbed by wind, water or maintenance operations, re-install existing or new materials and anchor to prevent displacement.
 - 3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- C. Watering: Native Seeded Areas are to be watered just enough to keep the soil moist, every other day for 15 minutes to one-half hour to maintain adequate surface soil moisture for proper seed germination. Watering shall continue for not less than 30 days following seeding. In the absence of naturally occurring rainfall events, soil shall be kept moist by watering every-other day for the first eight weeks. Water application rates shall be 1.5 times the average weekly rainfall for the maintenance period and watering shall continue until final acceptance during the active growing season.
- D. Mowing: Mow the planting when the cover reaches a height of 12" to 18" or before problem weed species produce seeds. Mowing shall not be performed if invasive species have gone to seed. Mow to a height of 6" except for first mowing which shall be to a 4" height.
 - 1. Expect two or three mowings the first season for a spring planting.
 - 2. If area is dormant (fall) seeded, the following growing season one mowing is required in mid-to-late June to a 6" height. Repeat mowings through the growing season when the cover reaches a height of 12" to 18".
 - 3. Mow with a flail type mower, which will finely chop taller vegetation and not smother the new seedlings.
- E. Herbicide Treatments: During the maintenance period, selectively spot treat all seeded areas with selective, non-persistent glyphosate-based herbicide to manage specific annual and/or perennial aggressive weeds that germinate. Specific herbicides shall be based on target invasive species and shall not hinder growth or kill turf species. Treat only on cool, windless days preferably by gloved hand wiping method or with a backpack sprayer and properly-fitted nozzle. Follow all label directions for use, application, and safety. Coordinate applications with the City's operations and others in proximity to the Work. Notify the City before each application is performed.
- F. Erosion Control Removal: At the end of the maintenance period, assuming a healthy and vigorous stand of bluegrass lawn has been established, Contractor shall hand-remove any erosion control netting and biodegradable stakes from the project site and dispose of properly at no additional cost to the project.

3.12 SATISFACTORY INSTALLATIONS FOR BLUEGRASS LAWN AREAS

- A. Installations shall meet the following criteria for Satisfactory Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds, pests, and/or surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches
- B. If satisfactory areas have not been established at the end of the maintenance period, use specified materials to reestablish turf that does not comply with requirements and continue maintenance until installation is deemed satisfactory as set forth by the guidelines above and reviewed by the City's Project Representative.

3.13 SATISFACTORY INSTALLATIONS FOR NATIVE SEEDED AREAS

- A. Installations shall meet the following criteria:
 - 1. At end of maintenance period, a healthy, uniform, close stand of cover crop has been established, free of noxious weeds, pests, and/or surface irregularities, with aerial coverage exceeding 90 percent over the entire site. Germination of native species shall be confirmed by visual inspection with no less than 80 percent of species present.
- B. If satisfactory areas have not been established at the end of the maintenance period, use specified materials to reestablish areas that do not comply with requirements and continue maintenance until installation is deemed satisfactory as set forth by the guidelines above and reviewed by the City's Project Representative.

3.14 PESTICIDE AND HERBICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with City's operations and others in proximity to the Work. Notify the City before each application is performed. Contractor shall possess all training and certificates necessary.
- B. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.15 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by preparation, installation, and maintenance work from adjacent areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Erect temporary fencing or barricades and warning signs as required to protect newly installed areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after installations are established.
- C. Carefully remove by hand all biodegradable erosion-control material that has not degraded by the end of the establishment period and dispose of off-site.
- D. Remove seeded area demarcation stakes only after mature vegetation typologies have been established, or as requested by the City's Project Representative. The City may choose to keep demarcation stakes in-place even after Contractor's maintenance period has expired. Demarcation stakes shall become the property of the City, at no additional cost to the project, unless otherwise indicated or agreed upon.

END OF SECTION

**SECTION 32 92 23
SODDING****PART 1 GENERAL****1.01 DESCRIPTION**

- A. Treatment for weeds, installation of sodded lawns, Contractor-required maintenance, and satisfactory installation of sodded lawns.

1.02 RELATED WORK AND REQUIREMENTS

- A. Applicable provisions of Division 01 shall govern Work of this Section.
- B. Section 01 57 13 - Temporary Erosion and Sediment Control: for coordination of site and landscape installation work with erosion control measures.
- C. Section 31 22 00 - Grading: for coordination with excavation and subgrade preparation work.
- D. Section 32 14 13.13 - Miscellaneous Landscape Surfaces: for coordination with aggregate paths and installations.
- E. Section 32 91 13 - Soil Preparation: for at-grade soil quality, testing requirements, and depths.
- F. Section 32 92 19 - Seeding: for coordination with sodding.
- G. Section 32 93 00 - Plants: for coordination with planting and landscape materials and installations.

1.03 REFERENCES

- A. City of Madison Standard Specifications for Public Works Construction, Article 208 "Sodding". Current edition.

1.04 SUBMITTALS

- A. Product Data for Pesticides, Herbicides and/or Fertilizers: Include product label and manufacturer's application instructions specific to this Project.
- B. Sod Submittal: Submit a one-page typewritten note on sod suppliers letterhead, dated within one month of the submittal and in the same growing season as the installation will take place, indicating the composition of the sod and guaranteeing that it was grown in mineral soils and is free of pests, diseases, pathogens and is premium quality.
- C. Qualification Data: For qualified Landscape Installer whose work has resulted in successful short and long-term establishment and maintenance of and lawns from sod.
- D. Warranty: All sodded areas shall be under warranty for 12 months from the date of substantial completion. Submit Contractor's stated typewritten warranty on letterhead.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified Landscape Installer whose work has resulted in successful establishment of lawns from sod.
 - 1. Installer's Field Supervision: Installer is always required to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 2. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
 - 3. Pesticide Applicator: State licensed, commercial.
- B. Site-Wide Weed Control: Contractor shall continuously work to identify the presence of specific broadleaf weed or aggressive or invasive species and control of both annual and perennial weeds for the entire project site from the time of contract award to the time of final sod installation and establishment, through the end of the maintenance and warranty period. The Contractor shall periodically visit the site at various times during the growing season, even prior to sod installation, to update evaluations and treatment recommendations and to tailor the specific management plans to the anticipated dates of sod installation; visits shall continue through the duration of the maintenance period.

- C. Preinstallation Conference: Conduct conference at Project site with City's Project Representative, Installer's Supervisor, Plants Installation Contractor (if separate entity from turfs and grasses contractor), and any other Contractors or City's Representatives present.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers labeled as to name and address of supplier and indication of conformance with state and federal laws, as applicable.
Store packaged materials delivered prior to use in a manner safe from damage from heat, moisture, rodents, or other causes of degradation. Any damaged packaged materials shall be replaced by the Contractor at no additional cost to the project.
- B. Harvest, deliver, store and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.
- C. Protect sod from sun, wind and dehydration during transport to site. A Project Representative shall review the sod once it is delivered to the project site and prior to installation. The Representative reserves the right to reject the sod, at no additional cost to the project, if it is deemed unsatisfactory for any reason.
- D. Deliver any additional packaged materials in original, unopened containers labeled as to contents, name and address of manufacturer, and indication of conformance with State and Federal laws, if applicable.
- E. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
- F. Provide additional temporary erosion-control measures as necessary to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems or walkways.
- G. Accompany each delivery of bulk materials with appropriate certificates.

1.07 PROJECT CONDITIONS

- A. Planting Restrictions for Sod: Install during one of the following periods. Coordinate with other seeding and landscape installation operations and initial maintenance periods to provide required maintenance from date of planting completion.
 - 1. Spring Installation Season: May 1 to June 15.
 - 2. Fall Installation Season: August 15 to October 1.
- B. Do not install sod when the air temperature is above 95 deg. F or below 40 deg. F or onto frozen soil materials.
- C. Weather Limitations: Proceed with installations only when existing and forecasted weather conditions permit installations to be performed when beneficial and optimum results may be obtained. Apply all materials during favorable weather conditions according to manufacturer's written instructions and/or grower's instructions.
- D. Site Restoration and Soil Stabilization: Contractor shall coordinate with General Contractor to establish permanent vegetative cover for the entire project in the same growing season as earthmoving operations. If ongoing earthmoving and earthwork is anticipated in the following season, final vegetation restoration shall be delayed until all earthwork is completed and the entire site shall be stabilized with an annual cover crop or other approved means before the end of the construction season and no later than October 15 of any given year to ensure the project continues to meet all applicable erosion control permit requirements and that open soils over winter do not create erosion problems or violate permits.

1.08 MAINTENANCE AND WARRANTY

- A. Maintenance and Warranty: Maintenance and warranty of the installation is considered part of the contract. Compliance with the requirements herein is mandatory. In the event of question or dispute over applicability of any requirement, the requirement shall be assumed to apply, unless the Landscape Architect provides written clarification stating that it does not.
- B. Maintenance shall begin as soon as each individual area is installed and continue maintaining sod through the duration of sod installation. At the time of sodding completion, as determined by the Landscape Architect, the project's stated maintenance period will begin.
- C. Warranty: Installer agrees to warrant that healthy, vigorous and close stands of weed and pest free sodded have successfully established at the end of the warranty period under the condition that the City has maintained the sodded areas in conformance with this Section after the Contractor's required maintenance period expires. Installer agrees to repair or replace sodded areas and accessories that fail in materials, workmanship or growth at any time during the warranty period, using new materials. Sodded areas that fail in materials, workmanship, or growth within specified warranty period must be repaired or replaced by the Contractor at no additional cost to the project.
 - 1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse or incidents that are beyond Contractor's control.
 - b. Areas of pest infestation.
 - c. Areas of subsidence and/or cracks between sections of sod.
 - d. Excessive weed growth.
 - 2. Include the following remedial actions as a minimum:
 - a. Immediately repair areas that have been washed out, damaged, or disturbed by replacing soil with the appropriate Soil Material conforming to Section 32 91 13, "Soil Preparation" and re-establishing the surface cover with the same materials used in the original installation.
 - 3. Maintenance Period from Date of Sodding Completion: 12 months.
 - 4. Warranty Period from Date of Sodding Completion: 12 months.
- D. Maintenance: Provide full maintenance by skilled employees of Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is installed and continue to maintain through the duration of sodding operations for no less than the stated Contractor maintenance period.
- E. The contractor shall use appropriate means, methods and materials available to them to fulfill the requirements of the Contract and ensure the successful establishment of viable, healthy lawns via accepted industry standards.
- F. The contractor shall examine installed areas throughout the growing season following the installation for growth and shall determine, in coordination with City's Project Representative that all areas are on a successful path to establishment. In addition to regularly scheduled maintenance visits, the contractor shall make investigative site visits throughout the maintenance period a minimum of three times to assess invasives and to observe and report on establishment of species and shall provide these written reports to the City's Project Representative in a digital word document format.

1.09 COORDINATION

- A. Contractor shall coordinate all installation operations with other contractors working on site. Contractor shall coordinate specifically with landscape contractor(s) responsible for performing planting, seeding, landscape surfaces and stonework, and site furnishings installation operations (if separate contractor or crew from sodding installer) and/or other contractors performing site stabilization operations to eliminate conflicts in scheduling, materials storage, maintenance, and/or other coordination.

PART 2 PRODUCTS**2.01 BLUEGRASS SOD**

- A. Bluegrass Sod: Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted. Furnish mineral sod; peat sod is not acceptable.
 - 1. With not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:
 - 2. Full Sun: Kentucky bluegrass (*Poa pratensis*), a minimum of three cultivars.
- B. Install standard sections of sod of enough strength to support their own weight and to retain their size and shape when held within its upper ten (10) percent and suspended vertically.

2.02 LANDSCAPE EDGINGS

- A. Spaded Edging: Contractor shall provide a spaded edge without backfill material (i.e., no bark mulch fill) along the entire perimeter for all sodded areas abutting native seeded or plugged areas.

2.03 WATER

- A. Supply potable water during sodding installation and maintenance. In lieu of potable water, supply clean, clear water, free from harmful contaminants, from a source approved by the Landscape Architect. Contractor will be required to provide their own supplemental water source and delivery method (i.e., water trucks) and/or will be required to coordinate supply from the project site and reimburse the City for all utility charges associated with water used during construction and landscape maintenance activities.

2.04 SOIL MATERIALS

- A. Topsoil shall be provided for any repairs based on Specification Section 32 91 13, "Soil Preparation".

2.05 STARTER FERTILIZER FOR SODDED LAWNS

- A. Fertilizer designed for establishment of newly sodded bluegrass lawns only.
- B. Scotts® Starter® Fertilizer by the Scotts Miracle-Gro Company or approved equal.

2.06 PESTICIDES AND HERBICIDES

- A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

PART 3 EXECUTION**3.01 TREATMENT OF NOXIOUS WEEDS**

- A. The Contractor shall continuously monitor the site for weed germination and growth and utilize hand-removal (including root) or chemical herbicides to control weeds. Weed control and monitoring shall commence immediately upon mobilization to the project site and shall continue through the duration of construction at regular intervals whenever weed seedlings begin to appear.
 - 1. Contractor will be responsible for monitoring for presence of germinating weeds and treating the site on 10-day cycles.
 - 2. All herbicide applications shall be done by a licensed, trained professional and in accordance with the herbicide manufacturer's written instructions and all applicable codes and ordinances.
 - 3. Herbicide treatments shall only occur when existing and forecasted weather conditions permit effective application without overspray, drifting, blowing or forecasted rain events that would create washout or leeching.

4. Contractor shall post signage around the perimeter of the treated area before, during and after each herbicide application stating that treatment has occurred, the date of treatment, the chemical applied, and a contact phone number for the Contractor or herbicide applicator.
5. Contractor shall maintain a Treatment Log including the name of the project, project number, the date of each treatment, type of treatment (hand pulling vs chemical), chemical used, and name and contact information of applicator. The completed Treatment Log shall be included in the final O&M documentation for the project.

3.02 SODDING SCHEDULE OF REVIEWS

- A. The Contractor shall create a single-page, typewritten Sodding Review and Log including the name of the project, project number, the review schedule milestones, a line for dates completed and a line for signatures by the Contractor's Representative and A/E. The completed Log shall be included in the final O&M documentation for the project.
- B. Milestones shall include:
 1. After topsoil placement and final fine grading and prior to any sodding.
 2. After sod has been installed.
 3. Refer to Maintenance section for additional maintenance log requirements.

3.03 EXAMINATION

- A. Examine areas for compliance with requirements and other conditions affecting performance.
 1. It is the responsibility of the Contractor to verify that sufficient Soil Materials have been provided both in terms of quality and quantity (depths) as indicated in Section 32 91 13, "Soil Preparation" and that subgrades have been properly decompacted. If insufficiencies in soil materials or subgrade preparation occur, Contractor shall notify the City's Project Representative immediately and shall not begin any installation operations until any and all unsatisfactory conditions have been corrected.
 2. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within installation areas.
 3. Uniformly moisten excessively dry soil that is not workable, and which is too dusty.
- B. If contamination by foreign deleterious material or liquid is present in soil within an area to be installed, remove the entire extent of the contaminated soil as directed by the City's Project Representative and replace with new soil material.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.04 PREPARATION, GENERAL

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by installation operations.
 1. Protect adjacent and adjoining areas from sodding operations.
 2. Protect grade stakes set by others until directed to remove them.
- B. Install any temporary erosion-control measures as necessary to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways during installation operations.

3.05 PREPARATION FOR SODDING

- A. Limit preparation to areas to be sodded. Remove any and all undesirable vegetation that has germinated in the areas to be sodded.
- B. Finish Grading: Grade areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation.
- C. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be immediately sodded.

- D. Moisten prepared area if soil is dry. Water thoroughly and allow surface to dry before sodding. Do not create muddy soil.
- E. No installation shall occur on frozen ground or at temperatures lower than 32 deg. F.

3.06 SODDING

- A. Lightly pre-wet sod. Handle all material with care to minimize damage to roots and vegetated top growth. Keep moist and cool at all times at the install site.
- B. Lay sod within 24 hours of harvesting unless a suitable preservation method is accepted by the Landscape Architect and the grower prior to delivery time. Do not lay materials if they are dormant or if ground is frozen or muddy.
- C. Lay to form a solid mass with tightly fitted joints. Butt ends and sides of material; do not stretch or overlap. Stagger to create offset joints in adjacent courses. Avoid damage to soil or vegetated materials during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of material; remove excess to avoid smothering sod.
- D. Lay sod across slopes exceeding 1:3.
 - 1. Anchor sod on slopes exceeding 1:6 with wood pegs spaced as recommended by grower but not less than two anchors per sod strip to prevent slippage.
- E. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.
- F. Erosion control blanket is not required for areas installed with sod.
- G. Provide a spaded edge without backfill material (i.e., no bark mulch fill) along the entire perimeter for all sodded areas abutting native seeded or plugged areas.

3.07 CLEANING AND REPAIR

- A. Waste and excess material from the installation operations shall be promptly removed. Adjacent paved areas are to be cleaned, and any damage to existing adjacent turf areas, planting areas, or other features shall be repaired.
- B. Erect temporary fencing or barricade warning signs as required to protect newly installed areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove only after the installations are established.

3.08 MAINTENANCE OF SODDED LAWNS

- A. Begin maintenance immediately after sodding and continue until the end of the specified maintenance period.
- B. Maintain and establish turf by watering, fertilizing, weeding, mowing, removing trash or debris, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, re-grade, and replant bare or eroded areas to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
 - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
 - 2. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- C. Watering: Sodded areas are to be watered daily to maintain adequate soil surface moisture for proper establishment and rooting. Watering shall continue for not less than 30 days following installation. Thereafter, apply 1/2" of water twice weekly until final acceptance.
 - 1. Schedule watering to prevent wilting, puddling, erosion, and displacement of sod, fertilizers, or other materials. Lay out temporary watering system to avoid walking over muddy or newly planted areas.

- D. Mowing: Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
1. Mow lawn to a height of 2-1/2 inches before June and after September and no less than 3" from June through September.
 2. Mowing operations include trimming around obstacles and raking of excess grass clippings. String trimmers shall not be used around trees or shrubs.
 3. Any plant material damaged at any time during turfgrass maintenance shall be replaced at the original size and species at no cost to the project.
- E. Turf Postfertilization: Apply fertilizer after initial mowing and when grass is dry if results of soil test confirm the need for fertilizers and within compliance with local ordinances. Use fertilizer that will provide actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

3.09 SATISFACTORY INSTALLATIONS FOR SODDED AREAS

- A. Installations shall meet the following criteria as determined by the City's Project Representative: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 95 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches. Joints or gaps between rolls of sod shall not be visible; brown patches or sections of sod are unacceptable. Sod shall be well-rooted into topsoil below as tested by gently attempting to lift representative sections of sod from the soil.
- B. If satisfactory areas have not been established at the end of the maintenance period, use specified materials to reestablish areas that do not comply with requirements and continue maintenance until installation is deemed satisfactory as set forth by the guidelines above and reviewed by the City's Project Representative.

3.10 PESTICIDE AND HERBICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with City's operations and others in proximity to the Work. Notify the City before each application is performed. Contractor shall possess all training and certificates necessary.
- B. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.11 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by preparation, installation, and maintenance work from adjacent areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Erect temporary fencing or barricades and warning signs as required to protect newly installed areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after installations are established.

END OF SECTION

**SECTION 32 93 00
PLANTS****PART 1 GENERAL****1.01 DESCRIPTION**

- A. Section includes plants and landscape materials and installations, biofiltration basin planting and surfacing, mulches, landscape edging, and miscellaneous landscape materials and constructions.

1.02 RELATED WORK AND REQUIREMENTS

- A. Applicable provisions of Division 01 shall govern Work of this Section.
- B. Section 01 57 13 - Temporary Erosion and Sediment Control: for coordination of site and landscape installation work with ongoing erosion control measures.
- C. Section 32 14 13.13 - Miscellaneous Landscape Surfaces: for coordination with aggregate paths and installations.
- D. Section 32 91 13 - Soil Preparation: for at-grade soil quality, testing requirements, and depths.
- E. Section 32 92 19 - Seeding: for coordination with seeding installation.
- F. Section 32 92 23 - Sodding: for coordination with sodding.

1.03 REFERENCES

- A. American Standards for Nursery Stock, ANSI Z60.1, current edition. American Association of Nurserymen, Inc.
- B. Standardized Plant Names, Second Edition (1942). American Joint Committee on Horticulture Nomenclature, Horace McFarland Company, Harrisburg, PA.
- C. American National Standard for Tree Care Operations – Tree, Shrub and Other Woody Plant Maintenance – Standard Practices, ANSI A300, current edition.
- D. State of Wisconsin, Department of Transportation, Standard Specifications for Highway and Structures Construction (WisDOT SSHSC). Current edition.
- E. City of Madison Standard Specifications for Public Works Construction, Article 106.2 for inspections and Article 209 – Trees, Shrubs, Perennials and Grasses.

1.04 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
 - B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than sizes indicated for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.
 - C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than sizes indicated for type and size of plant required.
 - D. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching the sides of the container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.
 - E. Finish Grade: Elevation of finished surface of planting soil.
 - F. Planting Soil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce a soil blend. See Section 32 91 13, "Soil Preparation".
 - G. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
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- H. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- I. Planting Area: Areas to be planted.
- J. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- K. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- L. Soil Materials: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; engineered soils for above structures, and/or planting soil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 32 91 13, "Soil Preparation".
- M. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.
- N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- O. Subsoil: All soil beneath the topsoil layer of the soil profile and typified by the lack of organic matter and soil organisms.
- P. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.05 SUBMITTALS

- A. Product Data: For each type of product indicated:
 - 1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials. Provide list(s) for all plant material to Landscape Architect two (2) weeks in advance of ordering plant materials and/or planting. Include any Requests for Plant Substitution with the Plant Source submittal. See Substitutions for additional requirements.
 - a. Note: Native plug material may require custom growing. Contractor shall contact native plant suppliers immediately upon the award of this contract to ensure plant plugs of the size and species listed in the project documents are pre-grown and timed with overall landscape installation.
 - 2. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to the Project.
- B. Installation Methodology for Biofiltration Basin(s): Provide, in writing to Landscape Architect, intended method of installing plugs for biofiltration areas, including anticipated planting dates and any additional materials, if necessary, to ensure optimal installation
- C. Planting Schedule: Indicating anticipated installation dates for plants and landscape materials. Contact the Landscape Architect to coordinate planting at least (7) seven working days prior to the start of planting operations.
- D. Plant Non-Availability: In order to request a substitution of plant material, the Contractor must submit, in writing, a request for substitution and a letter or e-mail from a minimum of three (3) major nurseries in the State of Wisconsin indicating they are not able to provide the specific plant material at the size specified. The Contractor shall suggest a substitution to a different available size or a different variety or species all-together. Requests for substitution will be reviewed by the Landscape Architect and a written response will be provided to the Contractor. The Contractor shall not proceed with ordering or installing any requested substitutions until receipt of written approval from the Landscape Architect.
- E. Samples for Verification: For each of the following:

1. Bark Mulch: 1-pint volume of organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
 2. Stone Mulch: 1-gallon volume of mulch required, in sealed plastic bags labeled with source of mulch. Sample shall be typical of the lot of material to be delivered and installed on the site; provide an accurate indication of color, texture, and makeup of the material.
 3. Filter Fabric for Stone Mulch Areas: 12" x 12" square.
 4. Erosion Control Material for Biofiltration Areas: 12" x 12" square.
- F. Qualification Data: For qualified landscape Installer with a minimum of three years of experience installing projects of a similar scale, including the successful installation and establishment of plants for large commercial at-grade and rooftop projects.
- G. Maintenance Instructions: Contractor shall submit a long-term maintenance plan for planting and landscape installations. Maintenance plan shall include recommendations for treating invasives and other long-term plant and landscape maintenance procedures requested by the City. The Plan shall be for a period of 5 years and include general information on a maintenance cycle beyond five years. The Plan shall be provided to the City in the form of a digital and hard-copy text document with associated figures, photographs, and/or other supplementary material. A draft of the long-term maintenance plan shall be submitted for review to the City and Landscape Architect before the end of the initial maintenance period. The document shall be considered a working document and shall be updated during the entire maintenance period. A final version of the maintenance document, including any revisions based on field-adjusted maintenance based on site conditions and plant health, shall be submitted to the City and the Landscape Architect before expiration of the required maintenance period.
- H. Warranty: All plant material shall be under warranty for 12 months from date of substantial completion.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of plants for commercial, retail and/or health care projects of a similar size and within 500 miles of this project site.
1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 2. Experience: Five years' experience in landscape installation in addition to requirements in Division 01 Section "Quality Requirements."
 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 4. Pesticide Applicator: State licensed, commercial
- B. Site-Wide Weed Control: Contractor shall continuously work to identify the presence of specific broadleaf weed or aggressive or invasive species and control of both annual and perennial weeds for the entire project site from the time of contract award to the time of final turfs and grasses installation and establishment, through the end of the maintenance and warranty period. The Contractor shall periodically visit the site at various times during the growing season, even prior to turfs and grasses installation, to update evaluations and treatment recommendations and to tailor the specific management plans to the anticipated dates of landscape installation; visits shall continue through the duration of the maintenance period.
- C. Conduct a Preinstallation Conference at the project site with, at a minimum, the Installer's project supervisor, the General Contractor, and Landscape Architect present.
- D. Plants are to be inspected upon delivery to Project site and the Landscape Architect or City's Project Representative may reject any specimens no longer meeting the specified standards or that have been damaged in transit.

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- E. Planting Layouts:
1. Contractor shall stake the locations of all trees and shrubs and obtain Landscape Architect's approval of staked locations before any excavation or planting operations commence.
 2. Contractor shall use marking paint to lay out locations of all plant beds and obtain Landscape Architects approval of bed locations, sizes, and shapes prior to excavation, planting, edging, or mulching operations.
 3. Contractor shall contact Landscape Architect at least seven (7) working days in advance of planting operations to coordinate review and approval of staked locations and to coordinate planting bed layouts.
- F. If any discrepancies occur between the plant schedule and/or plant labels and the actual plant symbols placed in the plans, the plants placed in the plans shall govern. Contractor will be responsible for verifying that all quantities are correct based on individual plant symbols placed in the plans prior to ordering and installation.
- G. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
- H. All plant material shall be true to species and variety/hybrid/cultivar specified, and nursery grown in accordance with good horticultural practices, and under climatic conditions similar to those of the site location. Specimens nursery-dug to be replanted shall have been freshly dug and properly prepared for planting.
- I. Plant Plug Age: All plant plugs for biofiltration basins shall have a minimum two-year old equivalency and meet the requirements of ANSI Z60.1, current edition. All plugs shall have a minimum of 6-9 inches of top growth at the time of planting; plants without this minimum will be rejected. Plant species and spacing is indicated in the Working Drawings.
- J. Trees and Shrubs:
1. Shall be trained in development and appearance as to be superior in form, compactness, and symmetry. Trees with multiple leaders, unless specified otherwise, and shrubs with damaged or cut mainstem(s), will be rejected.
 2. With a damaged, cut, or crooked leader, abrasion of bark, sunscald, frost crack, disfiguring knots, insects (including eggs and larvae) or insect damage, cankers/cankorous lesions or fungal mats, mold, prematurely-opened buds, or cuts of limbs over $\frac{3}{4}$ " diameter that are not completely callused will be rejected.
 3. Multi-stem material shall be free of crotch angles in branching structure and shall not have intertwined or overlapping stems.
 4. Shall have healthy, well-developed root systems, and be free from physical damage or other hindrances to healthy growth.
 5. Balled and burlapped plants shall be dug with solid balls of a diameter not less than that recommended by the American Standards for Nursery Stock, and of sufficient depth to include both fibrous and feeding roots. Balls shall be securely wrapped with burlap, and tightly bound with rope or twine. No plants shall be bound with rope or wire in such a manner as to damage bark or break branches. The root flare should be within the top 2" of the soil ball. Balled and burlapped plants will not be accepted if the ball is dry, cracked, or broken before or during planting.
 6. Containerized plants are to be well-established within the container, with a root system sufficiently developed to retain its shape and hold together when removed from the container. Soil within the container should be held together by the roots, in form and whole. Plants shall not be pot-bound, nor have kinked, circling, or bent roots.
- K. Herbaceous perennials and grasses shall only be supplied from nurseries certified by state plant inspectors.
- L. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
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1. Plants shall conform to the measurements specified within the contract documents. Specified height and spread dimensions will refer to the main body of the plant, and not from branch tip to branch tip. Plants meeting a specified measurement but judged to lack the balance between height and spread characteristics of the species will be rejected.
 2. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
 3. Other Plants: Measure with stems, petioles, and foliage in their normal position.
 4. Herbaceous perennials shall be measured by pot size, and top growth shall be indicative of a well-rooted, mature plant at the specific pot size. Herbaceous perennials that are not well-rooted in the pot and/or display weak top growth based on their container size will be rejected.
 5. All other measurements, such as number of canes, ball sizes, and quality designations, shall conform to American Standards for Nursery Stock.
- M. Plant Material Observation: Landscape Architect retains right to observe trees, shrubs and other plant material for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Contractor shall remove rejected plant material immediately from Project site.
1. Notify Landscape Architect when plant material is ready for observation and coordinate so as not to cause any delay in construction.
- N. Percolation Testing: Contractor shall perform percolation testing for all individual trees planted in lawn areas and for all planting bed areas. The tests shall be performed by digging a flat-bottomed hole, 12-inches in diameter, to the depth of the rootball or planting bed, and filling it with water. After the water has drained from the hole, it shall be filled again, and the drainage recorded. If the second drainage takes an excess of one hour, Contractor shall notify the A/E and additional soil preparation or drainage controls may be required.

1.07 SUBSTITUTIONS

- A. The substitution of plant material is not permitted unless authorized in writing by the Landscape Architect. If written proof is submitted by the Contractor that the plant of the specified species, variety, or size is unavailable, consideration will be given towards the nearest available size or variety, or towards an alternate species selection, with a potential adjustment of the contract price.
- B. Larger plants than those specified can be used upon approval of the Landscape Architect or Project Representative. The use of larger plants shall not increase the contract price. The root ball, root spread and container size of the larger specimen shall be proportionally increased, relative to the specified size.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.
- B. Bulk Materials:
 1. Do not dump or store bulk materials near structures, utilities, walkways, and pavements, or on existing turf areas or plants.
 2. Provide additional erosion-control measures necessary to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
- C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

- D. Handle planting stock by root ball and/or container.
- E. Deliver plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in a shaded location, protect from weather and mechanical damage, and keep roots moist.
 - 1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 - 2. Do not remove container-grown stock from containers before time of planting.
 - 3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.09 PROJECT CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Interruption of Existing Services or Utilities: Do not interrupt services or utilities unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:
 - 1. Notify City's Project Representative no fewer than two days in advance of proposed interruption of each service or utility.
 - 2. Do not proceed with interruption of services or utilities without Representative's written permission.
- C. Planting Restrictions: Planting shall occur during the following acceptable installation periods:
 - 1. Deciduous trees and shrubs – April 1 to November 15.
 - 2. Evergreen trees and shrubs – April 1 to October 15.
 - 3. Perennials ornamental grasses and native plugs – April 1 to September 15.
- D. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.
- E. Coordination with Turf Areas: Plant trees, shrubs, and other plants after finish grades are established and before seeding or sodding turf areas unless otherwise indicated or unless seeded areas are required for erosion control or permitting reasons.
 - 1. When planting trees, shrubs, and other plants after seeding or sodding turf areas, take extraordinary measures to protect turf areas, and promptly repair damage caused by planting operations with like materials at no additional cost to the project.
- F. Contractor shall protect all existing and/or newly installed plants, lawns, and grass areas from damage at all times. Damaged plants, lawns or grass areas shall be replaced or treated as required to conform to specifications herein for fresh stock. Work area shall be kept clean and orderly during the installation period. Under no condition shall debris from planting activities result in a safety hazard on-site or to adjacent off-site property. Damage to site improvements or adjacent landscapes incurred as a result of planting or replacement operations shall be repaired by the Contractor that causes the damage at no cost to the project.

1.10 MAINTENANCE AND WARRANTY

- A. Maintenance and Warranty: Maintenance and warranty of the installation is considered part of the contract. Compliance with the requirements herein is mandatory. In the event of question or dispute over applicability of any requirement, the requirement shall be assumed to apply, unless the Landscape Architect provides written clarification stating that it does not.

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- B. Maintenance shall begin as soon as each individual area is installed or planted and continue maintaining through the duration of plants and landscape materials installation. At the time of planting and landscape materials completion, as determined by the Landscape Architect, the project's stated maintenance period will begin.
 - C. Warranty: Installer agrees to warrant that healthy, vigorous plants have successfully established at the end of the warranty period under the condition that the City has maintained the planted areas in conformance with this Section after the Contractor's required maintenance period expires. Installer agrees to repair or replace plants and landscape installations and accessories that fail in materials, workmanship or growth at any time during the warranty period, using new materials. Planted and landscaped areas that fail in materials, workmanship, or growth within specified warranty period must be repaired or replaced by the Contractor at no additional cost to the project.
 - 1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse or incidents that are beyond Contractor's control.
 - b. Structural failures including plantings falling or blowing over.
 - c. Faulty performance of tree stabilization, edgings, and mulches.
 - 2. Include the following remedial actions as a minimum:
 - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
 - b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
 - c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.
 - d. Remove and replace and landscape materials or installations that are determined to be improperly installed or are failing in materials or workmanship at any time during the maintenance and warranty period.
 - 3. Maintenance Period from Date of Planting and Landscape Materials Installation Completion: 12 months.
 - 4. Warranty Period from Date of Planting and Landscape Materials Installation Completion: 12 months.
 - D. Maintenance: Provide full maintenance by skilled employees of Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is installed and continue to maintain through the duration of planting and landscape materials operations for no less than the stated Contractor maintenance period.
 - E. The contractor shall use appropriate means, methods and materials available to them to fulfill the requirements of the Contract and ensure the successful establishment of viable, healthy plants via accepted industry standards.
 - F. The contractor shall examine installed areas throughout the growing season following the installation for growth and shall determine, in coordination with City's Project Representative that all areas are on a successful path to establishment. In addition to regularly scheduled maintenance visits, the contractor shall make investigative site visits throughout the maintenance period a minimum of three times to assess invasives and to observe and report on establishment of species and shall provide these written reports to the City's Project Representative in a digital word document format.

1.11 COORDINATION

- A. Contractor shall coordinate all installation operations with other contractors working on site. Contractor shall coordinate specifically with landscape contractor(s) responsible for performing seeding, sodding, landscape surfaces and stonework, and site furnishings installation operations (if separate contractor or crew from sodding installer) and/or other contractors performing site stabilization operations to eliminate conflicts in scheduling, materials storage, maintenance, and/or other coordination.

PART 2 PRODUCTS**2.01 TREE, SHRUB, AND PERENNIAL PLANT MATERIALS**

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant List shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
 - 1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots will be rejected.
 - 2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a state certified nursery.
 - 3. Plant material shall be provided in the container type indicated in the drawings (B&B, Container, Bare Root, etc), unless the Contractor receives written approval from the Landscape Architect that substitution of container type is acceptable.
- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.
- D. Labeling: Label only one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on Drawings. Remove all tags and labels once Landscape Architect has reviewed all plantings on-site.
- E. If formal arrangements or consecutive order of plants is shown on Drawings, select stock for uniform height and spread.

2.02 WATER

- A. Supply potable water during planting and landscape installation and maintenance. In lieu of potable water, supply clean, clear water, free from harmful contaminants, from a source approved by the Landscape Architect. Contractor will be required to provide their own supplemental water source and delivery method (i.e., water trucks) and/or will be required to coordinate supply from the project site and reimburse the City for all utility charges associated with water used during construction and landscape maintenance activities.

2.03 SOIL MATERIALS

- A. Refer to Section 32 91 13 "Soil Preparation" for topsoil testing requirements, planting soil materials and blends to be used for all planting beds, for fertilizers, and for additional requirements related to preparation for and placement of soil materials.

2.04 MULCHES

- A. Bark Mulch (Organic Mulch): Shredded bark mulch for mulch rings to be provided at the base of all trees in lawn areas and as top-dressing for planting beds in locations indicated in the Drawings.
 - 1. Size Range: Maximum 2 1/2" to 3"
 - 2. Color: Natural, un-dyed.
 - 3. Provide 3" depth of mulch for 4-foot diameter bark mulch rings at the base of all trees that are not planted within already mulched beds i.e., in lawn areas.
 - 4. Provide 3" depth of mulch for all planting beds indicated as Bark Mulch Planting Bed.
 - 5. Sample: Submit sample of mulch to Landscape Architect for approval before installation.
- B. Stone Mulch: Hard, durable stone, washed free of loam, sand, clay, and other foreign substances, of following type, size range, and color:

1. Material: Washed, rounded clear stone.
2. Size: 1.5"
3. Color range: blend of buff, & light brown tones.
4. Sample: Submit sample of mulch to Landscape Architect for approval before installation.

2.05 PESTICIDES

- A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.06 TREE STABILIZATION MATERIALS

- A. Stakes and Guys for temporarily stabilizing at-grade plantings:
 1. Temporarily stabilize all trees subject to damage by wind and/or trees planted on slopes of 4:1 or greater.
 2. Upright Stakes: Painted steel posts, 14-gauge steel, 6-foot height, with ground anchor plate for stability and metal tabs.
 - a. Basis of Design: Model No. H-4637, Safety Fence Post, by Uline (www.uline.com), or approved equal.
 3. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes or turnbuckles.
 4. Guys and Tie Wires: ASTM A 641/A 641M, Class 1, galvanized-steel wire, two-strand, twisted, 0.106 inch in diameter.
 5. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.

2.07 LANDSCAPE EDGINGS

- A. Metal Edging: Standard-profile, commercial-grade, extruded-aluminum edging, ASTM B 221, Alloy 6063-T6, fabricated in standard lengths with interlocking sections with loops stamped from face of sections to receive stakes.
 1. Basis of Design: Cleanline XL by Permaloc, or approved equal.
 2. Edging Size: 1/8-inch-wide by 3 inches deep.
 3. Stakes: Aluminum, ASTM B 221, Alloy 6061-T6, 18-inches long.
 4. Finish: Black.
- B. Spaded Edging for Trees: Contractor shall provide a spaded edge, backfilled with Shredded Hardwood Bark Mulch, for all trees planted in lawn areas at the outside edge of the bark mulch ring.
- C. Shovel-cut Edging: Contractor shall provide a shovel cut edge, backfilled with Shredded Hardwood Bark Mulch, for all planting beds adjacent to lawns and/or as indicated in the Drawings.

2.08 WEED-CONTROL BARRIERS

- A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally encountered chemicals, alkalis, and acids.
- B. Utilize weed control fabric only under at-grade Stone Mulch areas; do not otherwise utilize in at-grade planting beds mulched with bark mulch.

2.09 MISCELLANEOUS PRODUCTS

- A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

- B. Burlap: Non-synthetic, biodegradable. Use only as a necessary means of protecting plant material from desiccation by sun and/or wind.
- C. Erosion Mat for Biofiltration Areas: Provide Curlex II erosion control blanket by American Excelsior (www.americanexcelsior.com or 1-800-777-7645), or approved equal, for all areas where native plugs will be installed.
- D. Refer to Civil Engineer's plans, plan notes, and details for information related to engineered soil composition, standards and construction of biofiltration areas.

PART 3 EXECUTION

3.01 TREATMENT OF NOXIOUS WEEDS

- A. The Contractor shall continuously monitor the site for weed germination and growth and utilize hand-removal (including root) or chemical herbicides to control weeds. Weed control and monitoring shall commence immediately upon mobilization to the project site and shall continue through the duration of construction at regular intervals whenever weed seedlings begin to appear.
- B. Contractor will be responsible for monitoring for presence of germinating weeds and treating the site on 10-day cycles.
- C. All herbicide applications shall be done by a licensed, trained professional and in accordance with the herbicide manufacturer's written instructions and all applicable codes and ordinances.
- D. Herbicide treatments shall only occur when existing and forecasted weather conditions permit robust application without overspray, drifting, blowing or forecasted rain events that would create washout or leeching.
- E. Contractor shall post signage around the perimeter of the treated area before, during and after each herbicide application stating that treatment has occurred, the date of treatment, the chemical applied, and a contact phone number for the Contractor or herbicide applicator.
- F. Contractor shall maintain a Treatment Log including the name of the project, project number, the date of each treatment, type of treatment (hand pulling vs chemical), chemical used, and name and contact information of applicator. The completed Treatment Log shall be included in the final O&M documentation for the project.

3.02 PLANTING SCHEDULE OF REVIEWS

- A. The Contractor shall create a single-page, typewritten Planting Review and Log including the name of the project, project number, the review schedule milestones, a line for dates completed and a line for signatures by the Landscape Architect. The completed Log shall be included in the final O&M documentation for the project.
- B. Milestones by Landscape Architect / City's Project Representative and/or City Forestry shall include:
 - 1. Percolation testing for all planting beds and excavations for trees planting in lawns.
 - 2. Planting bed preparation (planting mixture placement, fine grading, etc.).
 - 3. Plant inspection upon delivery to the project site and prior to planting.
 - 4. Plant bed layout and tree staking location inspection prior to installation of edging materials and/or plants.
 - 5. Interim review of planting to ensure planting hole excavations are sized and shaped correctly, plants are being properly prepared, root ball material is being completely removed, plants are being set at correct elevations, and immediate watering of all plant material is occurring .
 - 6. Review of all planted materials prior to mulching.
 - 7. Review of filter fabric and metal edging installation prior to installing stone mulch surfacing.
 - 8. Review of all planting beds and mulch rings at the base of trees planted in lawns after mulching.

3.03 EXAMINATION

- A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.

1. It is the responsibility of the Landscape Contractor to verify that sufficient Soil Materials have been provided both in terms of type, quality, quantity (depths) as indicated in Section 32 91 13 "Soil Preparation". If insufficiencies in soil materials occur, Landscape Contractor shall notify Landscape Architect immediately and shall not begin any planting operations until all unsatisfactory conditions have been corrected.
 2. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within planting areas.
 3. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
 4. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 5. Uniformly moisten excessively dry soil that is not workable, and which is too dusty.
- B. If contamination by foreign deleterious material or liquid is present in soil within an area to be planted, remove the entire extent of the contaminated soil as directed by the City's Project Representative and replace with new Soil Materials conforming to Section 32 91 13, "Soil Preparation".
- C. Drainage: Perform percolation test indicated in this Section for all individual tree excavations and for planting bed areas.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.04 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install temporary erosion-control measures as necessary to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.
- D. Contractor shall contact Landscape Architect at least seven (7) working days in advance of planting to coordinate plant layout. Landscape Architect shall approve staked locations of trees, layout of planting beds, and otherwise coordinate planting locations and operations.
- E. Locate all public, private and agency utilities prior to excavation. Notify Digger's Hotline (1-800-242-8511 statewide) to verify location of all underground utilities prior to excavation and bed preparation.
- F. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- G. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.
- H. No planting shall occur on frozen ground or at temperatures lower than 32 deg. F.

3.05 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits as indicated in Working Drawings. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
1. Excavate approximately a minimum of two times as wide as ball diameter for balled and burlapped stock.

2. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
 3. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
 4. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
 5. Maintain supervision of excavations during working hours.
 6. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
- B. Subsoil and topsoil removed from excavations may be used as planting soil if they conform to the requirements outlined in Section 32 91 13 "Soil Preparation" or, in the case of rooftop applications, if they conform to growing media requirements.
- C. Obstructions: Notify City's Project Representative if unexpected rock or obstructions detrimental to plant health and growth are encountered in excavations.
- D. Drainage: Notify City's Project Representative if subsoil conditions evidence unexpected water seepage or retention in planting areas.
- E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.06 TREE AND SHRUB PLANTING

- A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements. Plant material planted without root flare visible or planted too low will be re-planted at the request of the Landscape Architect at no additional cost to the City.
- B. Plants found to have stem girdling roots and/or kinked roots at the time of planting will be rejected and replacements shall be provided at no additional cost to the project.
- C. Remove all twine, string, wire, and all other non-biodegradable material entirely from root ball area.
- D. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.
1. Use soil materials from excavation for backfill.
 2. Carefully cut and remove burlap, rope, and wire baskets from the entire root ball. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 4. Continue backfilling process. Water again after placing and tamping final layer of soil.
- E. Set container-grown stock plumb and as indicated on Drawings with root flare 1 inch above adjacent planting soil elevations as indicated on Drawings.
1. Use soil materials from excavation for backfill.
 2. Carefully remove root ball from container without damaging root ball or plant.
 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 4. Continue backfilling process. Water again after placing and tamping final layer of soil.

3.07 TREE AND SHRUB PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Prune, thin, and shape trees, shrubs, and vines as directed by Landscape Architect.

- C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Landscape Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.
- D. Do not apply pruning paint to wounds.

3.08 TREE STABILIZATION

- A. Install temporary tree stabilization measures for any/all other at-grade trees only as follows:
 - 1. Stake trees only as required to prevent wind tip out and/or in any areas where slopes exceed 25 percent. Stake trees if requested by a Project Representative. Use a minimum of three stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend one-third of trunk height above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.
 - 2. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
 - 3. Use brightly colored material plastic or cloth ribbon to flag all ties and/or guy wires.

3.09 PERENNIAL AND ORNAMENTAL GRASS PLANTING IN PLANTING BEDS

- A. Ensure that appropriate quality and depth Soil Materials have been provided for entire extents of planting beds, monolithically, so that planting bed excavation is a single, contiguous volume of well-prepared subgrades and soil materials.
- B. Examine areas to receive plantings. Ensure additional conformance for depths and preparations and soil materials per Section 32 91 13, "Soil Preparation".
- C. Set out and space plants as indicated in Working Drawings and obtain layout approval from Landscape Architect before proceeding with installation.
- D. Dig holes large enough to allow spreading of roots. Loosen roots, scarifying lightly by hand to loosen roots for each and every plant prior to placing in the planting hole.
- E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.
- H. Mulch entire planting bed with a 3" layer of shredded hardwood bark mulch, pulling mulch back from the base of each individual plant by hand as indicated in the drawings such that mulch does not touch the base of any plant material.

3.10 BIOFILTRATION AREA INSTALLATION

- A. Refer to Civil Engineer's plans, plan notes, and details for information related to engineered soil composition, standards and construction of biofiltration areas.
- B. Contractor shall perform the following quality control functions before, during, and after planting:
 - 1. Inspect prepared biofiltration area and surroundings for conformance with contract documents and for contamination by deleterious materials or sediments.
 - 2. Ensure that temporary riprap siltation areas have been excavated and the material removed and that the void where siltation shelves were installed has been backfilled with native subsoils, engineered soils, or topsoil to match the originally specified material, lightly compacted, and finished even with adjacent bottom of basin grades.
 - 3. Inspect all native plant plug material upon delivery to the site and reject any and all plant material that is damaged, unhealthy, or otherwise unsatisfactory. Refer to quality requirements in this Section for additional specifications.
 - 4. Store plant material in shaded location before planting and keep plant material away from exposure to sun, wind, and other desiccating conditions.

5. Ensure that plant material is well watered at time of delivery and continues to be watered between delivery and planting.
- C. Install Curlex II Erosion-Control materials in the bottom and sides of all biofiltration basins where native plugs will be installed. Install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer with manufacturer's recommended biodegradable stakes.
- D. Plant plugs into engineered soil.
- E. Contractor shall take care to minimize compaction of the basin soils during erosion control and plant installation and shall start planting at the center of the basin and work outward toward the edges, relying in plywood planks or other means to disperse weight of installation personnel.
- F. Water plants immediately after installation.

3.11 EDGING INSTALLATION

- A. Stone Mulch with Metal Edging (Stone Mulch Maintenance Edge):
 1. Fine grade all Stone Mulch Maintenance Edge areas to pitch outward, away from building foundation or center of planting bed.
 2. Lightly compact areas to receive Stone Mulch.
 3. Install metal edging in accordance with manufacturer's written instructions. Anchor with aluminum stakes spaced approximately 36 inches apart, driven below top elevation of edging.
 4. Install weed barrier fabric in accordance with manufacturer's written instructions; completely cover area to be mulched, overlapping edges of fabric lengths a minimum of 6-inches, and securing seams with galvanized pins. Weed barrier fabric shall be wrapped vertically up the outside edges of the mulched areas (along the inside face of edging and/or concrete flatwork or curb) and also vertically up the inside edges of the mulched areas (along building foundations) and secured in place. If edging is not turned and wrapped up vertical edges, the Contractor will be required to remove and re-install the entire area.
 5. Ensure that metal edging and weed barrier fabric is properly installed and secured before installing Stone Mulch. Obtain review and approval of edging and filter fabric installation from Landscape Architect prior to installing stone.
 6. Place and finish Stone Mulch as indicated in Working Drawings, ensuring a smooth, level top surface for all stone mulch areas held approximately $\frac{1}{2}$ " below top lip of metal edging and/or $\frac{1}{2}$ " below the top surface of any adjacent paved or paver area.
- B. Provide a spaded edge for all trees planted in lawn areas. Backfill with shredded hardwood bark mulch, toe tamp, and provide additional mulch as required to finish top mulch surface of shovel cut edge areas at or slightly (+/- $\frac{1}{2}$ ") above adjacent soil grades.
- C. Provide a shovel cut edge, 6" x 6", to separate planting beds from adjacent lawn areas. Backfill with shredded hardwood bark mulch, foot tamp, and apply additional mulch as required to finish top mulch surface of shovel cut edge areas at or slightly (+/- $\frac{1}{2}$ ") above adjacent soil grades.

3.12 PLANT MAINTENANCE, GENERAL

- A. Begin maintenance immediately after plant installation continue for the stated maintenance period.
- B. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting, and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.
- C. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- D. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

- E. Contractor shall be responsible for the removal of all temporary, at-grade stakes and guys at the end of the warranty period unless explicitly requested to be left in-place by the Landscape Architect or City's Project Representative. Subsurface root ball anchoring systems over below-grade structures are to remain in place for the lifetime of the tree; do not excavate or remove these systems.
- F. Watering: Water supplemental water as necessary to establish and maintain healthy plant material. Permanent irrigation will not be installed in all planting areas; Contractor will be responsible for providing supplemental water from watering trucks or other source to maintain plants. Contractor shall coordinate with the City of Madison's Project Representative to work out details of usage and payment for supplemental watering if building sources are used. Contractor shall coordinate all supplemental watering ensure underwatering or overwatering does not occur, in coordination with natural weather events and conditions. Contractor shall monitor plant health and water needs on a weekly basis throughout the maintenance period.

3.13 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with City's operations and others in proximity to the Work. Notify City before each application is performed.

3.14 SATISFACTORY INSTALLATIONS

- A. Installations shall meet the following criteria as determined by Landscape Architect:
 - 1. At the end of the maintenance period, a flourishing selection of plants shall be established with well-mulched tree rings and/or plant beds, free of noxious weeds and surface irregularities. Plants shall be in a healthy and flourishing condition with no signs of drought stress, broken limbs, disease(s), chlorosis, or other correctable conditions. Plant health shall be confirmed by visual inspection.
 - 2. No wash-out of soil or stone materials, damaged sections of edging, missing or irregularly installed landscape materials will be observable.
 - 3. No broken, chipped, stained, or otherwise damaged stone mulches are installed.
 - 4. Edging is straight, even, and securely staked without signs of warping, wavy, undulating installation lines, properly set to the height indicated in the Drawings.
 - 5. Biofiltration basins have achieved nearly 100% coverage with no bare areas exceeding 6" x 6" and without the presences of annal or perennials weeds, woody pioneer seedlings, trash, debris or other detrimental materials.

3.15 CLEAN-UP AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- C. After installation remove all nursery tags, nursery stakes, tie tape, labels, wire, string, and other debris from plant material, planting areas, and Project site.

3.16 DISPOSAL

- A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off City's property.

END OF SECTION

SECTION 32 94 47.13
FACTORY FABRICATED TRELLIS PANELS -NATURESCREEN

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. NatureScreen Panels:
 - 1. Wire Mesh, Stainless Steel: Single or double layer for supporting plant growth.
 - 2. Wire Mesh, Galfan: Single or double layer for supporting plant growth.
 - 3. Frame, Extruded Aluminum: With retention groove designed to capture wire mesh on one or two sides. Powder coated finish.
 - 4. Mounting, Posts: Extruded aluminum post system. Powder coated finish.
 - 5. Recommended clips, spacers, and attachment hardware.

1.02 RELATED SECTIONS

- A. Section 07 42 33 - Phenolic Wall Panels: Coordination of penetrating trellis supports.
- B. Section 32 93 00 - Plants.

1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM B 221 - Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire Profiles, and Tubes.
- B. The Aluminum Association, Inc. (AA):
 - 1. AA ADM-1516166 - Aluminum Design Manual.
- C. American Society of Civil Engineers (ASCE):
 - 1. ASCE 7-18 - Minimum Design Loads for Buildings and Other Structures.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data:
 - 1. Manufacturer's data sheets on each product to be used.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Typical installation methods.
 - 5. Sufficient data and detail to indicate compliance with these specifications.
- C. Verification Samples: Two representative units of each material type.
 - 1. Mesh Gauge diameter and spacing size.
 - 2. Powder-coated aluminum.
 - 3. Aluminum Composite Material with Graphics.
- D. Color Selection: Submit paint chart with full range of colors available for Architect's selection. Custom color samples available upon purchase.
- E. Shop Drawings: Indicate layout heights, component connection details, and details of interface with adjacent construction.
 - 1. Wall or ground area to be screened.
 - 2. Number of individual panels desired.
 - 3. Type of mounting System: Wall material to be attached to, direct bury of posts or surface mounted posts system.
- F. Print proof if graphics are required.
- G. Certification: Manufacturer's Certificate of Compliance certifying that panels supplied meet or exceed requirements specified.

- H. Closeout Submittals: Warranty documents, issued and executed by manufacturer, countersigned by Contractor.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum of one year documented experience.
- B. Installer Qualifications: Company specializing in performing Work of this section with minimum two years documented experience with projects of similar scope and complexity.
- C. Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity.
- D. Mock-Up: Construct a mock-up with actual materials in sufficient time for Architect's review and to not delay construction progress. Locate mock-up as acceptable to Architect and provide temporary foundations and support.
 - 1. Intent of mock-up is to demonstrate quality of workmanship and visual appearance.
 - 2. If mock-up is not acceptable, rebuild mock-up until satisfactory results are achieved.
 - 3. Retain mock-up during construction as a standard for comparison with completed work.
 - 4. Do not alter or remove mock-up until work is completed or removal is authorized.

1.06 PRE-INSTALLATION CONFERENCE

- A. Convene a conference approximately two weeks before scheduled commencement of the Work. Attendees shall include Architect, Contractor and trades involved. Agenda shall include schedule, responsibilities, critical path items and approvals.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.
- B. Storage and Handling: Keep product in original package until ready to install to protect materials and finishes during handling and installation.

1.08 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.
- B. Field Measurements: Take measurements of actual openings to be screened. Indicate measurements on shop drawings fully documenting any field condition that may interfere with the screen system installation.

1.09 COORDINATION

- A. Installer for work under this Section shall be responsible for coordination of panel and framing sizes and required options with the Contractor's requirements.
- B. Submit shop drawings to the Contractor and obtain written approval of shop drawing from the Contractor prior to fabrication.

1.10 WARRANTY

- A. If any part of the NatureScreen system fails because of a manufacturing defect within 1 to 5 years from the date of substantial completion, the manufacturer will furnish without charge the required replacement parts. Any local transportation, related service labor or diagnostic call charges are not included.
- B. This warranty does not cover failure of your NatureScreen System if the Owner damages it, or if the failure is caused by improper installation. In no event shall Warrantor be liable for incidental or consequential damages.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: CityScapes International Inc.,
 - 1. 4200 Lyman Ct., Hilliard, OH 43026;
 - 2. Toll Free: 877-SCREENS; Phone: 614-850-2549;
 - 3. Email: contact@cityscapesinc.com;
 - 4. Web: <https://cityscapesinc.com/>
- B. Substitutions:
 - 1. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Regulatory Requirements: Comply with requirements of building authorities having jurisdiction in Project location.
- B. Basis of Design: NatureScreen System by CityScapes International Inc
- C. Design Criteria:
 - 1. Manufacturer is responsible for the structural design of all materials, assembly, and attachments to resist snow, wind, suction, and uplift loading at any point without damage or permanent set.
 - 2. Framing shall be designed in accordance with the Aluminum Design Manual to resist the following loading:
 - a. ASCE 7-18 - Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers.

2.03 MATERIALS

- A. Frame: Extruded Aluminum Alloy 6005-T5. Wall Thickness: 0.063 inches (1.60 mm).
- B. Frame Width:
 - 1. Frame Profile Size DMT: 3 x 1 inch (76 x 25 mm).
- C. Custom Mount System: See drawings for mounting knife plate detail mounted through phenolic wall panel directly to CMU backup wall. Panel to extend 3 inches beyond the face of the metal panel siding.
- D. Coordinate trellis supports and locations with Phenolic Wall Panel manufacturer.
- E. Metal Mesh Panels:
 - 1. Material: Stainless steel.
 - 2. Mesh Wire Size: 6 gauge. 0.192 inches (4.88 mm).
 - 3. Mesh Grid Size: 2 x 2 inch (51 x 51 mm).
 - 4. Maximum Single Panel Size: 60 x 120 inches (1524 x 3048 mm). Larger sizes are available with seams.
 - 5. Refer to drawings for final panel sizes.
- F. Threaded Fasteners: Screws, Bolts, Nuts and Washers: Stainless steel.

2.04 FABRICATION

- A. Panel Design, Style, Trim:
- B. Double Mesh Trellis (DMT) Panels: Fabricated and shipped as assembled units.
 - 1. Panel Style: Custom Post mount.
 - 2. Panel Design (select all that apply):
 - a. Straight.
 - b. Custom sizes. See Drawings.

2.05 FINISHES

- A. Aluminum Framing: Powder Coated finish.
 - 1. Color: White Satin

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Installer's Examination: Examine conditions under which construction activities of this section are to be performed.
 - 1. Submit written notification to Architect and Screen manufacturer if such conditions are unacceptable.
 - 2. Beginning erection constitutes installer's acceptance of conditions.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions, approved submittals, and in proper relationship with adjacent construction.
 - 1. Custom Mounting System.
 - 2. Coordinate trellis supports and design with Phenolic panel manufacturer. See Section 07 42 00.
 - 3. Overhead Horizontal or Inclined Panels Span Between Structural Supports: Not to exceed 60 inches (1524 mm).
 - 4. Install panels plumb and square, aligned to maintain modular grid.
 - 5. Install fasteners as shown on Drawings or according to manufacturer's requirements, whichever is more stringent.

3.04 CLEANING AND PROTECTION

- A. Do not use abrasive cleaners.
- B. Protection:
 - 1. Ensure that finishes and structure of installed systems are not damaged by subsequent construction activities.
 - 2. If minor damage to finishes occurs, repair damage in accordance with manufacturer's recommendations.
- C. Prior to Substantial Completion: Remove dust or other foreign matter from component surfaces; clean finishes in accordance with manufacturer's instructions.

END OF SECTION

SECTION 33 01 10.58
DISINFECTION OF WATER UTILITY PIPING SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Disinfection of site domestic water lines and site fire water lines specified in Section 33 14 16.
- B. Disinfection of building domestic water piping specified in Section 22 10 05.
- C. Testing and reporting results.

1.02 RELATED REQUIREMENTS

- A. Section 31 02 00 - General Requirements for Sitework
- B. Section 22 10 05 - Plumbing Piping: Disinfection of building domestic water piping system.
- C. Section 33 14 16 - Site Water Utility Distribution Piping.

1.03 REFERENCE STANDARDS

- A. AWWA B300 - Hypochlorites 2018.
- B. AWWA B301 - Liquid Chlorine 2018.
- C. AWWA B302 - Ammonium Sulfate 2023.
- D. AWWA B303 - Sodium Chlorite 2018.
- E. AWWA C651 - Disinfecting Water Mains 2014, with Addendum (2020).
- F. Standard Specifications for Sewer and Water Construction In Wisconsin, Current Edition, with Addendum.
- G. City of Madison Standard Specifications for Public Works Construction, latest edition
 - 1. Section 33 01 10.58 - Disinfection of Water Utility Piping Systems: Disinfection of site service utility water piping.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. See Section 31 02 00 - General Requirements for Sitework - Administrative Requirements, for submittal procedures.
- C. Test Reports: Indicate results comparative to specified requirements.
- D. Certificate: From authority having jurisdiction indicating approval of water system.
- E. Certificate: Certify that cleanliness of water distribution system meets or exceeds specified requirements.
- F. Disinfection report:
 - 1. Type and form of disinfectant used.
 - 2. Date and time of disinfectant injection start and time of completion.
 - 3. Test locations.
 - 4. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
 - 5. Date and time of flushing start and completion.
 - 6. Disinfectant residual after flushing in ppm for each outlet tested.
- G. Bacteriological report:
 - 1. Date issued, project name, and testing laboratory name, address, and telephone number.
 - 2. Time and date of water sample collection.
 - 3. Name of person collecting samples.
 - 4. Test locations.

5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
6. Coliform bacteria test results for each outlet tested.
7. Certification that water complies, or fails to comply, with bacterial standards of Standard Specifications for Sewer and Water Construction In Wisconsin, Current Edition, With Addendum.

1.05 QUALITY ASSURANCE

- A. Water Treatment Firm: Company specializing in disinfecting potable water systems specified in this Section with minimum three years documented experience.
- B. Testing Firm: Company specializing in testing potable water systems, certified by governing authorities of the State in which the Project is located.
- C. Submit bacteriologist's signature and authority associated with testing.

PART 2 PRODUCTS

2.01 DISINFECTION CHEMICALS

- A. In accordance with City of Madison Standard Specifications for Public Works Construction, Part VII, Article 702.6

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping system and water well has been cleaned, inspected , and pressure tested.
- B. Schedule disinfecting activity to coordinate with start-up, testing, adjusting and balancing, demonstration procedures, including related systems.

3.02 DISINFECTION

- A. Use method prescribed by the applicable state or local codes, or health authority or water purveyor having jurisdiction, or in the absence of any of these follow AWWA C651.
- B. Provide and attach equipment required to perform the work.
- C. Inject treatment disinfectant into piping system.
- D. Maintain disinfectant in system for 24 hours.
- E. Flush, circulate, and clean until required cleanliness is achieved; use municipal domestic water.
- F. Replace permanent system devices removed for disinfection.
- G. Pressure test system to ____ psi. Repair leaks and re-test.

3.03 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 40 00.
- B. Test samples in accordance with AWWA C651.

END OF SECTION

SECTION 33 05 61 CONCRETE MANHOLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Monolithic concrete manholes with masonry transition to lid frame, covers, anchorage, and accessories.
- B. Modular precast concrete manhole sections with tongue-and-groove joints with masonry transition to lid frame, covers, anchorage, and accessories.
- C. Masonry manhole sections with masonry transition to lid frame, covers, anchorage, and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 04 20 00 - Unit Masonry: Masonry units and mortar and grout.
- C. Section 33 42 11 - Stormwater Gravity Piping.
- D. Section 33 42 30 - Stormwater Drains.

1.03 REFERENCE STANDARDS

- A. ASTM A48/A48M - Standard Specification for Gray Iron Castings 2022.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- C. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete 2010a (Reapproved 2016).
- D. ASTM C270 - Standard Specification for Mortar for Unit Masonry 2019a, with Editorial Revision.
- E. ASTM C478/C478M - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections 2020.
- F. ASTM C923/C923M - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals 2020.
- G. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2022, with Errata.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manhole covers, component construction, features, configuration, and dimensions.
- C. Shop Drawings: Indicate manhole locations, elevations, piping sizes and elevations of penetrations.

1.05 QUALITY ASSURANCE

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

1.06 FIELD CONDITIONS

- A. Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

PART 2 PRODUCTS

2.01 MANHOLES

- A. Manhole Sections: Reinforced precast concrete in accordance with ASTM C478/C478M, with resilient connectors complying with ASTM C923/C923M.
 - B. Concrete: As specified in Section 03 30 00.
-

C. Mortar Mixing:

1. Ready Mixed Mortar: Type equivalent to that specified according to ASTM C270.
2. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.
3. Maintain sand uniformly damp immediately before the mixing process.
4. Do not use antifreeze compounds to lower the freezing point of mortar.
5. Waterproofing Admixture:
 - a. Manufacturers:
 - 1) ConShield Technologies, Inc; Crystal X: www.conshield.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
6. If water is lost by evaporation, retemper only within two hours of mixing.
7. Mortar and Grout: See Section 04 20 00, Type S.
8. Mortar and Grout: See Section 04 05 11, Type S.

2.02 COMPONENTS

- A. Cover: Removable, closed cover design; cover molded with identifying name.
- B. Proof Load: Medium duty.
- C. Manhole Steps: Formed galvanized steel rungs; 3/4 inch diameter. Formed integral with manhole sections.

2.03 CONFIGURATION

- A. Shaft Construction: Concentric with concentric cone top section; lipped male/female dry joints; sleeved to receive pipe sections.
- B. Shape: Cylindrical.
- C. Clear Inside Dimensions: As indicated.
- D. Design Depth: As indicated.
- E. Clear Lid Opening: As indicated.
- F. Pipe Entry: Provide openings as indicated.
- G. Steps: As indicated.

2.04 ACCESSORIES

- A. Adjustment Riser:
 1. Manufacturer:
 - a. EJ; INFRA-RISER ® Adjustment Riser: www.ejco.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify items provided by other sections of Work are properly sized and located.
- B. Verify that built-in items are in proper location, and ready for roughing into Work.
- C. Verify excavation for manholes is correct.

3.02 PREPARATION

- A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.

3.03 MANHOLES

- A. Place concrete base pad, trowel top surface level.
- B. Place manhole sections plumb and level, trim to correct elevations, anchor to base pad.
- C. Cut and fit for pipe.

- D. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour as required.
- E. Set cover frames and covers level without tipping, to correct elevations.
- F. Coordinate with other sections of work to provide correct size, shape, and location.

3.04 VACUUM TESTING OF MANHOLES

- A. Test sanitary sewer manholes leakage immediately after installation and prior to backfilling.
- B. Plug lift holes with non-shrink grout.
- C. Plug inlet and outlet pipes at manhole, taking care to securely brace plug to avoid its being drawn into manhole.
- D. Place vacuum test equipment inside top of cone section and inflate to 40 psi to affect a seal between vacuum base and structure.
- E. Draw a vacuum of 10 inches of mercury and shut-off vacuum pump.
- F. With valves closed, measure time for vacuum to drop to 9 inches.
- G. Manhole integrity is acceptable if time exceeds:
 - 1. 60 seconds for 48-inch diameter manhole.
 - 2. 75 seconds for 60-inch diameter manhole.
 - 3. 90 seconds for 72-inch manhole.
- H. If manhole fails initial test, make necessary repairs with non-shrink grout or other acceptable and approved materials.
- I. Continue retesting until a satisfactory test is obtained.
- J. Repair visible defective joints or leaks in manhole even though vacuum test requirements are met.
- K. Cost of equipment purchase or lease, materials, and labor necessary to conduct vacuum testing of manholes is incidental; include in cost bid for sanitary manhole construction.

3.05 EXFILTRATION/INFILTRATION MANHOLE TEST

- A. Construction Manager will visually inspect structure(s) for possible leaks prior to backfilling of structure.
- B. Reseal joints found to be unacceptable by Owner's Representative or Construction Manager.
- C. Owner's Representative or Construction Manager may require an exfiltration test for those structures for which a test is deemed necessary.
- D. Prior to and during exfiltration test groundwater level will be reduced to below manhole base.
- E. Suitably plug open pipes and other openings into manhole and brace to prevent blowout.
- F. Fill manhole with water to top of cone section or underside of flat top.
- G. If manhole has not been backfilled and visual inspection of exterior by Owner's Representative or Construction Manager reveals no leaks, vault may be considered to be satisfactorily watertight.
- H. If manhole has been backfilled or visual inspection is satisfactory, allow water to remain in manhole for a period of 4 hours to provide for absorption.
- I. Bring water in manhole top again and allowed to remain for a period of 8 or 16 hours.
- J. At end of time period, add water to vault to return level to top and measure and record quantity added.
- K. Extrapolate amount of water to a 24 hour time period and determine rate of exfiltration on basis of vertical foot.
- L. Leakage for each structure shall not exceed 1 gallon per vertical foot per day.
- M. If manhole does not meet this requirement but does not exceed 3 gallons per vertical foot per day, Owner's Representative or Construction Manager may permit repairs to structure to reduce leakage to required test level.

- N. Leakage due to defective section or in excess of 3 feet per vertical foot per day shall be cause for rejection.
- O. Uncover, disassemble, reconstruct or replace manhole structure as directed by Owner's Representative or Construction Manager and bear costs of correction.
- P. Upon reconstruction, retest manhole for compliance.
- Q. During testing, demonstrate to Owner's Representative and Construction Manager that water table is below bottom of manhole.

END OF SECTION

SECTION 33 14 16
SITE WATER UTILITY DISTRIBUTION PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Water pipe for site conveyance lines.
- B. Pipe valves.
- C. Fire hydrants.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete for thrust restraints.
- B. Section 31 02 00 - General Requirements for Sitework
- C. Section 09 91 13 - Exterior Painting.
- D. Section 21 11 00 - Facility Fire-Suppression Water-Service Piping.
- E. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.
- F. Section 33 01 10.58 - Disinfection of Water Utility Piping Systems: Disinfection of site service utility water piping.
- G. Section 33 05 61 - Concrete Manholes.

1.03 REFERENCE STANDARDS

- A. AASHTO HB - Standard Specifications for Highway Bridges 2005, with Errata.
- B. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 2021a.
- C. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40 2023.
- D. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 2020.
- E. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets 2020.
- F. AWWA C502 - Dry-Barrel Fire Hydrants 2018.
- G. AWWA C504 - Rubber-Seated Butterfly Valves 2023.
- H. AWWA C800 - Underground Service Line Valves and Fittings 2021.
- I. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. through 60 In. (100 mm through 1500 mm) 2022.
- J. UL 246 - Hydrants for Fire-Protection Service Current Edition, Including All Revisions.
- K. City of Madison Standard Specifications for Public Works Construction, latest edition
1. <https://www.cityofmadison.com/engineering/developers-contractors/standard-specifications>

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. See Section 31 02 00 - General Requirements for Sitework, for submittal procedures.
- C. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.
- D. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with utility company requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers with labeling in place.
- B. Protect crosslinked polyethylene tubing from direct and indirect UV exposure.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. See Section 31 02 00 - General Requirements for Sitework, for additional warranty requirements.
- C. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS**2.01 WATER PIPE**

- A. Pipe in accordance with City of Madison Standard Specifications for Public Works Construction, Part VII, Article 702
- B. Trace Wire City of Madison Standard Specifications for Public Works Construction, Part VII, Article 702

2.02 VALVES

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
 - 1. Valves, curb boxes, and curb stops in accordance with City of Madison Standard Specifications for Public Works Construction, Part VII, article 702.

2.03 HYDRANTS

- A. Hydrants: Type as required by utility company.
- B. Pressure Rating: According to utility company.
- C. Finish: Primer and two coats of enamel in color required by utility company.

2.04 BEDDING AND COVER MATERIALS

- A. Bedding: As specified in Section 31 23 16.13.
- B. Cover: As specified in Section 31 23 16.13.

2.05 ACCESSORIES

- A. All accessories in accordance with City of Madison Standard Specifications for Public Works Construction, Part V, Article 702. Including but not limited to:
 - 1. Polyethylene Encasement
 - 2. Fittings
 - 3. Nuts and Bolts
 - 4. Saddles
 - 5. Couplings
 - 6. Corporation Stops & Service Fittings
- B. Concrete for Thrust Restraints: Concrete type specified in Section 03 30 00.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that building service connection and municipal utility water main size, location, and invert are as indicated.

3.02 PREPARATION

- A. All work performed to be in accordance with City of Madison Standard Specifications for Public Works Construction, Part VII, Article 703. Including, but not limited to:
-

1. Connecting to Existing Water Mains
 2. Water Main Shutoffs
 3. Disinfection and Flushing
 4. Testing- conductivity, pressure, and quality
- B. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
 - C. Remove scale and dirt on inside and outside before assembly.
 - D. Prepare pipe connections to equipment with flanges or unions.

3.03 TRENCHING

- A. Utility trenching in accordance with City of Madison Standard Specifications for Public Works Construction, Part V
- B. Utility trenching in accordance with City of Madison Standard Specifications for Public Works Construction, Part VII, Article 703
- C. See the section on trenching for additional requirements.

3.04 INSTALLATION - PIPE

- A. All water utility work in accordance with Utility trenching in accordance with City of Madison Standard Specifications for Public Works Construction, Part VII, Article 703
- B. Install pipe to allow for expansion and contraction without stressing pipe or joints.

3.05 INSTALLATION - VALVES AND HYDRANTS

- A. All water utility work in accordance with Utility trenching in accordance with City of Madison Standard Specifications for Public Works Construction, Part VII, Article 703
- B. Set valves on solid bearing.
- C. Center and plumb valve box over valve. Set box cover flush with finished grade.
- D. Set hydrants plumb; locate pumper nozzle perpendicular to and facing roadway in accordance with Section 21 11 00.
- E. Set hydrants to grade, with nozzles at least 20 inches above ground in accordance with Section 21 11 00.
- F. Locate control valve 4 inches away from hydrant.
- G. Provide a drainage pit 36 inches square by 24 inches deep filled with 2 inches washed gravel. Encase elbow of hydrant in gravel to 6 inches above drain opening. Do not connect drain opening to sewer.
- H. Paint hydrants in accordance with Section 09 91 13.

3.06 SERVICE CONNECTIONS

- A. Provide water service to utility company requirements with reduced pressure backflow preventer and water meter with bypass valves and sand strainer.
- B. Anchor service main to interior surface of foundation wall.

3.07 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Perform field inspection and testing in accordance with Section 01 40 00.
- C. Pressure test water piping to ____ pounds per square inch.
- D. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

- E. Construction services by Water Utility provided per City of Madison Standard Specifications for Public Works Construction, Part VII, Article 708.18

END OF SECTION

SECTION 33 31 13
SITE SANITARY SEWERAGE GRAVITY PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sanitary sewerage drainage piping, fittings, and accessories.
- B. Connection of building sanitary drainage system to municipal sewers.
- C. Cleanout access.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete for cleanout base pad construction.
- B. Section 32 02 00 - General Requirements for Sitework
- C. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.
- D. Section 31 23 23 - Fill: Bedding and backfilling.
- E. Section 33 05 61 - Concrete Manholes.

1.03 DEFINITIONS

- A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.04 REFERENCE STANDARDS

- A. ASTM C443M - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric) 2021.
- B. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 2021a.
- C. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications 2020.
- D. ASTM D2680 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping 2020.
- E. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings 2021.
- F. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings 2023.
- G. City of Madison Standard Specifications for Public Works Construction, latest edition
 - 1. <https://www.cityofmadison.com/engineering/developers-contractors/standard-specifications>

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. See Section 32 02 00 - General Requirements for Sitework, for submittal procedures.
- C. Product Data: Provide data indicating pipe, and pipe accessories.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Project Record Documents:
 - 1. Record location of pipe runs, connections, manholes, cleanouts, and invert elevations.
 - 2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

PART 2 PRODUCTS**2.01 SEWER PIPE MATERIALS**

- A. Provide products that comply with applicable code(s).
- B. Plastic Pipe: Per City of Madison Standard Specifications for Public Works Construction Part V Article 503.2
- C. Joint Seals: Mechanical clamp ring type, stainless steel expanding and contracting sleeve, neoprene ribbed gasket for positive seal.
- D. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.
- E. Plastic pipe on site and within Public Right of Way - ASTM D3034 SDR 35 or SDR 26.

2.02 PIPE ACCESSORIES

- A. Trace Wire: Magnetic detectable conductor, clear plastic covering, imprinted with "Sewer Service" in large letters.
- B. Casing Spacer: Polyethylene spacer designed to maintain pipe casing integrity.
 - 1. Manufacturers:
 - a. Advance Products & Systems, LLC: www.apsonline.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - c. Substitutions: Section 32 02 00 - General Requirements for Sitework.
- C. Electronic Marker Ball: An Electronic Marker Ball in conformance with City of Madison Article 503.2(f) of the City of Madison Standard Specifications for Public Works Construction- Latest Edition above lateral at the property line and the sewer main where the lateral does not connect to a public structure (manhole (sewer access structure), cleanout). Electronic Marker Balls can be obtained at 1603 Emil Street - Contact Adam VandenHeuval 266-4515, avandenheuval@cityofmadison.com.

2.03 CLEANOUT MANHOLE

- A. Comply with requirements listed on the drawings.
- B. Lid and Frame: Cast iron construction, hinged lid.
 - 1. Lid Design: Open checkerboard grille.
 - 2. Nominal Lid and Frame Size: 26 inches.
- C. Shaft Construction and Concentric Cone Top Section: Reinforced precast Concrete pipe sections, lipped male/female dry joints, cast steel ladder rungs into shaft sections at 12 inches; nominal shaft diameter of 36 inches.
- D. Base Pad: Cast-in-place concrete of type specified in Section 03 30 00, levelled top surface to receive concrete shaft sections, sleeved to receive sanitary sewer pipe sections.

2.04 BEDDING AND COVER MATERIALS

- A. Pipe Bedding Material: As specified in Section 31 23 23.
- B. Pipe Cover Material: As specified in Section 31 23 23.
- C. City Right of Way- Pipe bedding installed within the Public City Right of Way shall conform to Article 502 of the City of Madison Standard Specification for Public Works Construction- Latest Edition.

PART 3 EXECUTION**3.01 GENERAL**

- A. Perform work in accordance with applicable code(s).
- B. Sewer Improvements on site and within City Right of Way
 - 1. All Sewer improvements within the Public City Right of Way shall conform to Article 500 of the City of Madison Standard Specifications for Public Work Construction- Latest Edition

3.02 TRENCHING

- A. See Section 31 23 16.13 for additional requirements.
- B. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.03 INSTALLATION - PIPE

- A. Install all sanitary sewer pipe per City of Madison Standard Specifications for Public Works Construction, Part V, Article 503.3

3.04 INSTALLATION - CLEANOUTS

- A. Install all cleanouts and risers per City of Madison Standard Specifications for Public Works Construction, Part V, Article 503.3
- B. Form bottom of excavation clean and smooth to correct elevation.
- C. Mount lid and frame level in grout, secured to top cone section to elevation indicated.

3.05 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 40 00.
- B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- C. Perform testing in accordance with requirements listed on the Drawings.

3.06 PROTECTION

- A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 33 42 11
STORMWATER GRAVITY PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Stormwater drainage piping.
- B. Stormwater pipe accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete for cleanout base pad construction.
- B. Section 31 02 00 - General Requirements for Sitework
- C. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.
- D. Section 31 23 23 - Fill: Bedding and backfilling.
- E. Section 33 05 61 - Concrete Manholes.
- F. Section 33 42 30 - Stormwater Drains.

1.03 REFERENCE STANDARDS

- A. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets 2021.
- B. ASTM C443M - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric) 2021.
- C. City of Madison Standard Specifications for Public Works Construction, latest edition
 - 1. <https://www.cityofmadison.com/engineering/developers-contractors/standard-specifications>

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the installation of stormwater gravity piping with size, location and installation of stormwater drains according to Section 33 42 30.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. See Section 31 02 00 - General Requirements for Sitework, for submittal procedures.
- C. Product Data: Provide data indicating pipe and pipe accessories.
- D. Project Record Documents:
 - 1. Record location of pipe runs, connections, and invert elevations.
 - 2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

PART 2 PRODUCTS

2.01 STORMWATER PIPE MATERIALS

- A. Provide products that comply with applicable code(s).
- B. All storm sewer products to comply with City of Madison Standard Specifications for Public Works Construction, Part V, Article 504
- C. Concrete Pipe Joint Devices: ASTM C443 (ASTM C443M) rubber compression gasket joint.

2.02 PIPE ACCESSORIES

- A. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.
- B. Trace Wire: Magnetic detectable conductor, clear plastic covering, imprinted with "Stormwater Service" in large letters.
- C. Flared End Section, in accordance with City of Madison Standard Specifications for Public Works Construction, Part V, Article 504
 - 1. Size as shown on the Drawings.

2.03 BEDDING AND COVER MATERIALS

- A. Bedding: As specified in Section 31 23 16.13.
- B. Cover: As specified in Section 31 23 16.13.

PART 3 EXECUTION**3.01 TRENCHING**

- A. See Section 31 23 16.13 - Trenching for additional requirements.
- B. Utility trenching in accordance with City of Madison Standard Specifications for Public Works Construction, Part V

3.02 INSTALLATION

- A. Install storm sewer pipes in accordance with City of Madison Standard Specifications for Public Works Construction, Part V Article 504

3.03 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 40 00 - Quality Requirements.
- B. Perform field inspection and testing in accordance with Section 31 02 00 - General Requirements for Sitework
- C. Perform field inspection and testing in accordance with Section 31 02 00 - General Requirements for Sitework,
- D. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

3.04 PROTECTION

- A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 33 42 30 STORMWATER DRAINS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Precast concrete catch basins.
- B. Prefabricated trench drains.
- C. Frames and grates.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 31 23 23 - Fill.
- C. Section 33 05 61 - Concrete Manholes.
- D. Section 33 42 11 - Stormwater Gravity Piping.
- E. Section 33 46 00 - Stormwater Management.

1.03 REFERENCE STANDARDS

- A. AASHTO HB - Standard Specifications for Highway Bridges 2005, with Errata.
- B. ACI 211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide 2022.
- C. ACI 301 - Specifications for Concrete Construction 2020.
- D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete 2000 (Reapproved 2009).
- E. ACI 305R - Guide to Hot Weather Concreting 2020.
- F. ACI 306R - Guide to Cold Weather Concreting 2016.
- G. ACI 318 - Building Code Requirements for Structural Concrete 2019 (Reapproved 2022).
- H. ASTM C150/C150M - Standard Specification for Portland Cement 2022.
- I. ASTM C478/C478M - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections 2020.
- J. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants 2009 (Reapproved 2019).
- K. ASTM C1634 - Standard Specification for Concrete Facing Brick and Other Concrete Masonry Facing Units 2023.
- L. ASTM G154 - Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials 2023.
- M. COE CRD-C 48 - Handbook for Concrete and Cement Standard Test Method for Water Permeability of Concrete 1992.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Installation of stormwater drains with piping and other structures.
 - 1. See Section 33 42 11 for stormwater gravity piping.
 - 2. See Section 33 05 61 for concrete manholes.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by affected installers.
- C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
-

- B. Product Data: Weight rating for catch basins and frame and grates.
- C. Designer's qualification statement.
- D. Manufacturer's qualification statement.
- E. Installer's qualification statement.

1.06 QUALITY ASSURANCE

- A. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.
- C. Installer Qualifications: Company specializing in installing work of the type specified in this section, and with at least three years of documented experience and approved by manufacturer.
- D. Documents at Project Site: Maintain one copy of manufacturer's instructions, assembly drawings, and shop drawings at the project site.
- E. Perform work of this section in accordance with ACI 301 and ACI 318.
 - 1. Maintain one copy of each document on site.
- F. Follow recommendations of ACI 305R when concreting during hot weather.
- G. Follow recommendations of ACI 306R when concreting during cold weather.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Trench Drains: As indicated on plans.
- B. Trench Drain Grates:
 - 1. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 CATCH BASINS

- A. Weight Rating: H 10 according to AASHTO HB.
- B. Precast Concrete Catch Basins: Comply with ASTM C478/C478M, reinforced.
 - 1. Wall Thickness: 6 inches (152 mm).
 - 2. Base Thickness: 12 inches (305 mm).
 - 3. Reinforcement: Formed steel wire, galvanized finish, wire diameter as indicated on drawings.
 - 4. Joint Sealant: Comply with ASTM C990.
- C. Grade Adjustments:
 - 1. Adjustment Rings as shown on plans
- D. Frames and Grates: Per City of Madison Standard
 - 1. R-3067 Frame, Curb Box, and Type R Grate

2.03 PREFABRICATED TRENCH DRAINS

- A. Prefabricated Trench Drain: Polymer concrete, glass fiber reinforced, metal installation brackets.
 - 1. Weight Rating: H 15 according to AASHTO HB.
 - 2. Bottom: Sloped.
 - 3. Ultraviolet Exposure: 10 years minimum, ASTM G154.
 - 4. Frames and Grates: Galvanized steel support, steel grate, linear pattern, match drain opening size.
 - 5. Products:
 - a. As indicated on drawings.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify items provided by other sections of work are properly sized and located.
- B. Verify built-in items are in proper location and ready for roughing into work.
- C. Verify excavation location and depth are correct.

3.02 EXCAVATION AND FILL

- A. Hand trim excavation for accurate placement to indicated elevations.
- B. Backfill with cover fill, tamp in place and compact, then complete backfilling.

3.03 INSTALLATION

- A. Establish elevations and pipe inverts for inlets and outlets as indicated in drawings.
- B. Precast Concrete Catch Basins:
 - 1. Place base section plumb and level.
 - 2. Install joint sealant uniformly around section lip.
 - 3. Install cone or lid plumb and level on joint sealant.
- C. Cast-In-Place Concrete Catch Basins:
 - 1. Form catch basin on excavation bottom plumb and level.
 - 2. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
 - 3. Place concrete in accordance with ACI 304R.
 - 4. Float catch basin top surface level.
- D. Prefabricated Drop Inlets or Trench Drains:
 - 1. Place base section plumb and level.
 - 2. Install according to manufacturer's instructions.
 - 3. Secure installation brackets.
- E. Grade Adjustments:
 - 1. Lay brick or masonry units uniformly on mortar bed with full head joints, running bond. Top with mortar, plumb and level.
 - 2. Lay concrete ring on mortar bed plumb and level. Top with mortar, plumb and level.
 - 3. Install expanded polypropylene ring according to manufacturer's instructions.
 - 4. Place adjacent materials tight and smooth following design grades.
- F. Frames and Grates:
 - 1. Place frame plumb and level.
 - 2. Mount frame on mortar bed at indicated elevation.
 - 3. Mount frame on expanded polypropylene ring according to manufacturer's instructions.
 - 4. Mount frame on prefabricated drop inlets or trench drains according to manufacturer's instructions.
 - 5. Place grate in frame securely.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Perform field inspection for pipe invert elevations.
- C. If inspections indicate work does not meet specified requirements, adjust work and reinspect at no cost to Owner.

END OF SECTION

**SECTION 33 46 00
STORMWATER MANAGEMENT**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Stormwater ponds.
- B. Outlet structures for stormwater ponds.

1.02 RELATED REQUIREMENTS

- A. Section 31 05 19 - Geosynthetics for Earthwork.
- B. Section 31 23 16.13 - Trenching.
- C. Section 31 23 23 - Fill.
- D. Section 33 05 61 - Concrete Manholes.
- E. Section 33 42 11 - Stormwater Gravity Piping.
- F. Section 33 42 30 - Stormwater Drains.

1.03 REFERENCE STANDARDS

- A. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures 2021.
- B. ASTM C923/C923M - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals 2020.
- C. ASTM D3282 - Standard Practice for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes 2015.
- D. ASTM D4873/D4873M - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples 2017 (Reapproved 2021).
- E. ASTM D6637/D6637M - Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method 2015.
- F. City of Madison Standard Specifications for Public Works Construction, current edition
 - 1. <https://www.cityofmadison.com/engineering/developers-contractors/standard-specifications>

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data on each product to be used, including physical properties, seaming materials, and installation instructions.
- C. Shop Drawings: Indicate stack assembly, invert elevations, opening sizes, and pipe angles.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.
- B. Documents at Project Site: Maintain at project site one copy of manufacturer's instructions and shop drawings.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Identify, store, and handle geosynthetic rolls in accordance with ASTM D4873/D4873M.
- C. Protect materials from sunlight and other ultraviolet light sources during storage.
- D. Handle geosynthetics with care and prevent dragging, dropping, or imbalanced lifting.

PART 2 PRODUCTS**2.01 STORMWATER PONDS**

- A. Fill: Per Plans
- B. Impermeable Layer: Group A-4 in accordance with ASTM D3282.

2.02 OUTLET STRUCTURES FOR STORMWATER PONDS

- A. Precast Concrete: Reinforced, integrated lift rings, in accordance with ASTM C913.
 - 1. Concrete: 4,000 psi minimum 28 day compressive strength.
 - 2. Wall Thickness: 4 inches (102 mm).
 - 3. Resilient Connectors: Natural rubber, in accordance with ASTM C923/C923M.
- B. Trash Racks: Cast iron, heavy duty bar screen.
 - 1. Coated with 1/20 inch thick bituminous coating.
- C. Apron endwalls
 - 1. in accordance with City of Madison Standard Specifications for Public Works Construction, Part V, Article 504

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verification of Conditions:
 - 1. Verify excavations are at correct topographies and areas to be filled are not compromised with surface or ground water.
 - 2. Verify items provided by other sections of work are properly sized and located.

3.02 PREPARATION

- A. Coordinate placement of inlet and outlet pipe required by other sections.

3.03 POND CONSTRUCTION

- A. Install water proof liner according to manufacturer's instructions. All stormwater systems to have water proof liner to prevent stormwater infiltration.
- B. Fill to contours and elevations indicated using unfrozen materials.
- C. Employ a placement method that does not disturb or damage other work.
- D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen, or spongy subgrade surfaces.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Granular Fill: Place and compact materials in equal continuous layers not exceeding 6 inches compacted depth.
- G. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches compacted depth. Install engineered soil fill on pond side slopes, as shown on drawings.

3.04 POND OUTLET CONSTRUCTION

- A. Precast Structure: Place structure sections plumb and level, trim to correct elevations.
 - 1. Anchor to base pad.
 - 2. Cut and fit for pipe.
 - 3. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour as required.
- B. Set trash racks level without tipping, to correct elevations.

END OF SECTION
